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NEW

ELEMENTS OF BOTANY.

NEW
ELEMENTS OF BOTANY,

BY

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MEMBER OF THE FACULTY OF MEDICINE OF PARIS;
ASSISTANT NATURALIST TO THE MUSEUM OF NATURAL HISTORY, ETC.

CONTAINING THE CHARACTERS

OF THE

NATURAL FAMILIES OF THE VEGETABLE KINGDOM;

WITH

PLATES EXHIBITING THE PRINCIPAL MODIFICATIONS

OF THE

ORGANS OF VEGETABLES.

TRANSLATED,

WITH NOTES, CHIEFLY ADAPTED FOR THE USE OF STUDENTS
IN MEDICINE AND PHARMACY,

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DUBLIN GENERAL DISPENSARY.

from FOURTH EDITION. of Richard

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TO

THE GOVERNOR AND DIRECTORS

OF APOTHECARIES' HALL, DUBLIN,

THIS TRANSLATION

OF RICHARD'S NEW ELEMENTS OF BOTANY

IS MOST RESPECTFULLY DEDICATED

BY THEIR OBEDIENT,

HUMBLE SERVANT,

P. CLINTON.

PREFACE.

Little celebrity can be acquired by writing an original work on the Elements of Botany, and still less by translating one; and yet nothing contributes more to the advancement or diffusion of any particular science than a well written work on its elements. The latter consideration alone is that which has induced me to undertake the translation of Richard's Elements of Botany, which I have now the honour of presenting to the Governor and Directors of Apothecaries' Hall. Placed by them in a situation where it became my duty to teach the Elements of Botany, I found it necessary, in order to discharge that duty well, either to write an original work on the subject, or to avail myself of one that was already written in a foreign language, and adapted to the latest improvements in the science. I have pre-

ferred the latter course, as that which was likely to supply the student, in the shortest possible time, with the proper means of studying an useful and beautiful science. In selecting Richard's Elements as a proper guide in the pursuit of Botanical knowledge, I have had in view, not only its merits as an introduction to Botany, but also the size of the work, and its probable expense to the purchaser. Other works might be selected which treat of each article more in detail, and are therefore too voluminous; but few contain so much solid information within so small a compass, and, on that account, are so well adapted for a class-book as Richard's Elements of Botany. Its favourable reception on the Continent, where it has passed through several editions, and where the study of Botany is pursued with the greatest ardour, bears strong testimony to its merits as an introduction to that science.

The fourth edition, of which the present work is a translation, is augmented by the addition of new and very valuable matter; it contains the characters of the natural families of the vegetable

kingdom. Partly, in order to render the view of their affinities more complete, and also for the purpose of communicating useful knowledge to the student, I have added to the author's description of many of the natural families, brief notices of their properties, and of their effects on the animal economy. When the properties of the families are either imperfectly known or uninteresting, I have added nothing to the original.

Those who wish to be better acquainted with the subject of these notes may consult Richard's Medical Botany, De Candolle on the Properties of Plants, American Medical Botany by Doctor Bigelow, Woodville's Medical Botany, Murray's Apparatus Medicaminum, &c. It is a subject which has already filled volumes, and can, therefore, be but slightly noticed in an Introduction to Botany. But even slight notices of it will serve to excite the curiosity of the student, and to point out to him the connexion between the botanical structure of vegetables and their properties, and will therefore accomplish the end which I have proposed in writing them.

The beautiful work of De Candolle on the General Laws of Vegetable Organization, his *Organographie Vegetale*, cannot be too strongly recommended to those students who are anxious to become acquainted with that branch of the science, nor his *Theorie Elementaire* to such as wish to study the general principles of Classification, Phytography, and Glossology.

AUTHOR'S ADVERTISEMENT

TO THE FOURTH EDITION.

The fourth edition of our Elements of Botany and Vegetable Physiology, which we this day publish, has been improved as much as possible, in order to justify by our efforts the daily increasing success which this work has obtained. Independently of the changes and additions which we have made in the different chapters, and, in particular, in those which treat of the structure of monocotyledonous stems, of the general organization of the flower, of that of the pollen and of its action in the process of fecundation, of that of the ovule before impregnation, &c., we must particularly distinguish the important addition of the characters of all the families of the vegetable kingdom. The number of families of which we here present a view, amounts to one hundred and sixty-two. It might have been still more considerable, if we wished to include in it all the families that have been successively proposed or established since the publication of the *Genera* Plantarum of M. De Jussieu. Not only have we united to other families already existing a considerable number of those that

have been recently proposed, but we have also thought that, in an elementary work, we might, without inconvenience, omit some families as yet but imperfectly known, whether as to their general characters, or as to the genera which ought to compose them, or lastly as to the situation which they ought to occupy in the series of natural families. We hasten to make this remark lest any one should accuse us of not having spoken in this work of several families which have been recently established.

We must also speak of the union which we have sometimes thought it our duty to make, of several families into one. In the present state of the science we think that there are perhaps more reductions to be made in the number of the genera and families, than there is room for the multiplication of their number. A rapid view taken of the changes experienced by Botany since the establishment of the method of natural families will sufficiently establish the truth of this remark. During the first years that followed the publication of the Genera Plantarum of Jussieu, that work, which even in our days is one of the noblest monuments raised to the glory of Botany, while to him who makes it his study, it is a source of knowledge, equally profound and certain, was the invariable rule which served to characterise both the genera and the families resulting from their union. But the advancement of the science occasioned by the deeper study of the fruit and of the seed, and the advantages which it afforded for the arrangement of genera and of families, produced remarkable changes in the study of Botany. It was found necessary to examine more deeply the organization of the different parts of the flower, and, in particu-

lar, of the ovary, of the seed, and of the fruit, which had been observed to furnish the most important characters for determining the natural affinities of vegetables. Accordingly, the genera united in each of the hundred natural families contained in the *Genera Plantarum* were submitted to a new examination, and from this more accurate analysis, directed particularly to the most essential organs, necessarily resulted the discovery of a great number of characters, of analogies, or of differences which had been before unnoticed.

This new direction given to the study of vegetables made it necessary to introduce modifications both into the circumscription of the genera, whose number was soon more than doubled, and even into that of the families themselves. During this first period of a new æra in the science, it was natural that Botanists, who daily discovered a crowd of modifications which had escaped their predecessors, should be more attentive to the differences observed between the genera and the families, than to the new relations which analysis revealed to them. In fact, at this period, the genera or the species which were examined to the bottom according to the principles of the new school, were too few in number, and too much isolated, not to exhibit a very considerable degree of dissimilarity; and, as it but too often happens in the study of the sciences, facts were too hastily generalized, which were as yet but isolated and single. Hence the great number of new genera and families which were successively established, and which soon became double that of the *Genera Plantarum*. But the impulse was given, and the proper road was opened. The analytical investigation, which was successively directed to a daily increasing number of vegetables, and

the discoveries of travellers, who every day supply new types of organization, must, in our opinion, gradually fill up many of the chasms which separate the groups that are already established. In the first period, each new analysis led to the discovery of a new modification of vegetable organization, which became, in some respect, an isolated type. But now that observations have been considerably multiplied, similar facts are collecting round the former, and by the various modifications presented by each, insensibly graduated shades have united them together, and formed them into that rarely interrupted chain which all accurate observers have admitted to exist among the productions of nature. In this new state of things, the strongly marked characters which had been formerly supposed to exist, whether between the species that compose the genera, or the genera united into families, are seen gradually to disappear. It necessarily follows, that as the differences disappear, the sections or divisions which had been founded on them must equally vanish. Accordingly, we repeat it, it is our opinion that the necessary effect of the present rapid progress of Botany will be to diminish considerably, both the number of the genera already established, and that of the groups or families resulting from their union. But the labour is very long, and still requires new observations. If we have sometimes objected to the opinions of others, we have done it with a cautious reserve and in perfect candour, not with the narrow and illiberal spirit of wishing to substitute our own opinions for those of our predecessors. In the arrangement of the families we have adopted the order presented by M. De Jussieu, in which we

have scarcely made any alterations. Besides, the particular method pursued is of little consequence, provided due attention be paid to the natural and evident affinities which exist between the different families; for it appears now to be demonstrated to the satisfaction of every man of sound understanding, that it is impossible, in a linear series, not frequently to interrupt the natural relations of vegetables; and whether we adopt as the basis of their divisions the insertion of the stamina, as was done by Jussieu, or the adhesion or non-adhesion of the ovary, as I have attempted in my MEDICAL BOTANY, there will be always numerous exceptions to point out the imperfection of such methods of classification.

As to the arrangement of the families themselves, we have in general preferred the name which they first received, not thinking that a mere change in the termination of that name would give another a title to the honour of having established the family. After the name of each we have cited the synonimes of the family, and the names of those whom we believe to be the authors of them. All our characters, with a few exceptions, owing to the want of materials, have been taken from nature, and very often a careful analysis of the genera of each family has induced us to modify the characters by which it has been heretofore distinguished. In an elementary work we have not thought it proper to give a minute account of those characters; but yet we have not omitted any thing which might serve clearly to distinguish from each other the different families; and as the fruit and the seed usually supply the most important characters, a description of them

always makes a part of the general character which we give of each family.

After the general characters we have added some observations either on the affinities of each family to those which are near it, or on its differences from them, or on the divisions or tribes which belong to it; or lastly, on the families which ought to be united with it. We have also been careful to enumerate the principal genera that compose it.

With respect to those who are destined for the healing art, and who, in the study of Botany, seek for a knowledge of the characters and medical properties of all the vegetables employed in practice, and of all the medicines derived from the vegetable kingdom, they will find in our MEDICAL BOTANY every thing in this part of natural history which it is of importance to the physician to be acquainted with.

In concluding this advertisement, we here renew the expression of our gratitude to those Professors who have done us the honour of recommending to their pupils the perusal of our book, and more particularly to M. M. Desfontaines, Professor to the Jardin du Roi; Guiart, Professor to the School of Pharmacy; Delile, Professor to the Faculty of Medicine of Montpellier; Nestler, Professor to the Faculty of Medicine of Strasbourg, &c.

NEW

ELEMENTS OF BOTANY.

INTRODUCTION.

Botany* (Botanica, res herbaria) is that part of natural history, whose object is the study of vegetables. This science does not consist, as has been long supposed, in a knowledge of the names given to the different plants; but it also considers the laws that preside over their general organization, the forms and functions of their organs, and the relations that unite them together.

Botany, viewed in reference to its most important applications, makes us, moreover, acquainted with the salutary or noxious qualities which belong to plants, and with the advantages

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* Derived from βοτανη, an herb, a plant.

we may derive from them in domestic economy, in the arts, and in the practice of medicine.

So vast a science must have been necessarily divided into many distinct branches, in order to facilitate its study; and this is what has actually happened.

1st. Thus botany, properly so called, is said to be that part of the science, which considers vegetables in a general way, with a view to know them, to describe them, and to reduce them to classes. This part of the science of vegetables is itself divided into:

Glossology,* or a knowledge of the terms fit to designate the different organs of plants, and their numerous modifications; this part teaches the language of Botany, with which language it is extremely important, that students should at the outset make themselves very familiar.

Taxonomy,† or the application of the general laws of classification to the vegetable kingdom. In this part are considered the different classifications proposed for the methodical arrangement of plants.

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* Derived from γλοσσα, a word, language, and λογος, discourse.

† From ταξις, order, and νομος, a law, i. e. laws of classification.

Phytography,* or the art of describing plants.

2d. The second branch of Botany bears the name of vegetable physics, or of organic Botany. It is that which considers vegetables as organised living beings, which reveals to us their internal structure, the *mode* of action belonging to each of their organs, and the changes which they may undergo, either in their structure or in their functions. Hence there are three secondary divisions in vegetable physics, to wit:

Organography,† or the description of organs, of their forms, of their positions, of their structure, and of their connexions.

Vegetable physiology, or the study of the functions belonging to each of those organs.

Vegetable pathology, which teaches us the different alterations or diseases which may occur in vegetables.

3d. Lastly, the name of the *application of Botany*, is given to that third branch of general Botany, which considers the relations existing between man and vegetables. It is subdivided into Agricultural Botany, or the application of the knowledge of vegetables, to the cultivation

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* φυτον, a plant, and γραφω, to describe.

† οργανον, an organ, and γραφω, to describe.

and improvement of the soil; into medical Botany, or the application of botanical knowledge to the determination of the vegetables which may serve as medicines, and from which the physician may derive advantage in the treatment of disease; into economical Botany, or that whose object it is to make known the utility of plants in the arts, and in domestic economy.

Botany being the science which has for its object the study of vegetables, we must first attempt to give an idea of the beings to which this name is applied.

Vegetables (in Latin, *vegetabilia, plantæ*, and in Greek, φυτα, βοταναι) are organised living beings, without sensation or voluntary motion,* but pos-

* Vegetables are destitute of voluntary motion. Some of them however execute a species of locomotion, or very sensible change of place, such for example are the orchideæ and colchicum. In fact, the roots of the greater part of the orchideæ have two fleshy tubercles, placed side by side, at the base of the stem. One of these tubercles, after giving birth to the stem, whose germ it contained within it, withers, contracts, and ultimately perishes. But in proportion as it disappears, a third is developed close to that part which still contains the rudiments of the stem, which is to appear on the following year, and replaces the former when it has vanished. This development of a new tubercle occuring each year, on one side of those which already exist, it will be seen that when

sessed of irritability, which is the distinctive character of all organised beings. It is by this property, in virtue of which they contract and move under the influence of certain agents, that organised beings resist the action of external causes, which have a continual tendency to destroy them.

It is extremely difficult to draw precisely the line of demarcation, which separates vegetables from animals. Linnæus, in his aphoristic style, has said, *minerals grow, vegetables grow and live, animals grow, live, and have feeling.* This distinction, which is indeed sufficiently clear, when we compare the rock crystal with the oak, and the latter with man, insensibly disappears, when we institute a comparison between the beings which occupy the extremes of these three great series.

In fact, it is very difficult to say, in what respect certain species of polypi differ essentially from some of the Algæ; for the essential character which is attributed to animals, namely, sensi-

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a new stem is produced, it is removed by a certain space from that which preceded it. The same thing happens, and nearly in the same manner, in regard to the meadow saffron, with the exception that its bulbs tend continually to sink deeper and deeper in the earth.

bility or the consciousness of existence, and the power of locomotion, are weakened, and ultimately disappear entirely in the lowest classes of the animal kingdom. Moreover, a great number of naturalists agree in considering as constant the transformation of certain plants into animals, and *vice versâ*. M. Agardh, a celebrated Algalogue, and professor of the university of Lund in Sweden, has published a curious dissertation on the metamorphoses of Algæ. Yet the opinion of the existence of these pretended metamorphoses appears to be the result of very careless observation.

But, neglecting for a moment the facts which serve as a connexion, as a transition between the two great divisions of organised beings, we can find well marked differences between animals and vegetables. For example, in the former, which have the power of locomotion, there is a system of contractile fibres, whose state of relaxation or of tension determines the motions of the animal; these are the muscular fibres; in vegetables there is nothing of the kind. Besides, they have nothing similar to a nervous system, although an ingenious experimentalist has compared them in this respect to animals. In the latter, the substances which are to serve for nutrition are first absorbed on the outer surface, they then remain a certain time in a particular cavity, where they

are duly elaborated before they are taken up by the chyliferous vessels, destined to convey them into the circulation ; but in vegetables, nutrition is carried on in a more simple manner. The substances absorbed are conveyed directly into all parts of the body, without undergoing any previous change, so that in them we find neither an intestinal canal nor a stomach, because there is no digestion. Vegetables differ also from animals as to the course of their fluids. In the latter, in fact, there is a true circulation, that is to say, the blood or the nutritious fluid departs from a point where it receives its impulse, is distributed through all parts of the body, where it deposits, on its way, the principals which are to serve for their nutrition, in order to return again to the point from which it set out. But in vegetables there is, properly speaking, no circulation ; the nutritious fluids are diffused through the vegetable, but they want that agent of impulse, the heart, which, in animals, is the point from which the blood takes its departure, and to which it finally returns. Animals always feed on organised animal and vegetable substances ; in vegetables, on the contrary, nutrition is carried on by means of inorganic bodies. Gases, water, salts, &c. are the substances which supply nutriment to vegetables. Moreover, in vegetables there are

no lungs, and therefore no respiration. Although there is an exhalation of gases, which have been absorbed, but not expended in nutrition, the nature of the rejected gases is very different in the two great classes of organised beings. Thus in animals it is carbonic acid, while in vegetables it is oxygen. Their chemical composition also furnishes some means of distinguishing vegetables from animals. Thus while carbon predominates in the former, a greater portion of azote is observed in the latter.

It would be easy to carry this comparison between vegetables and animals much farther; but what we have said will probably be sufficient to shew the chief points of difference between them.

Anatomy shews us that vegetables are composed of simple and similar elementary parts, which, combining in various ways, constitute organs, properly so called. We shall now enter on the examination of these elementary parts, whose study constitutes vegetable anatomy.

OF THE ELEMENTARY PARTS OF VEGETABLES, OR VEGETABLE ANATOMY.

When the internal organization of a vegetable is examined with the naked eye, or still better, with the eye armed with a magnifier or a microscope, it is found to be composed of cells with thin and diaphanous walls, which are extremely minute and of various forms, sometimes regular, sometimes irregular, and of cylindrical tubes or vessels, either scattered or united in bundles. Such are the two principal forms, under which appear the elementary parts, that enter into the composition of vegetables, and which have received the names of cellular tissue and of vascular tissue.

Of the Cellular Tissue.

The first modification of the elementary tissue of vegetables is the cellular tissue. (See pl. 1. fig. 7.) It is composed of cells contiguous to each other, and whose form generally depends on the resistance which they meet with. Some authors have compared it to the froth, or light foam, which is formed on soap water by the agitation of

that fluid. It was generally supposed that the walls of two contiguous cells were common to both; but yet Malpighi advanced the opinion that it was composed of distinct vesicles, which he called utricles. In 1802 Professor Sprengel of Halle, and a crowd of other distinguished physiologists, made observations which confirm this opinion. The cells may be separated without tearing, which proves that each cell forms a kind of small vesicle, which has distinct parietes, and that where the two cells meet, the membrane which separates them is formed of two layers, which belong respectively to each of them. The recent inquiries of M. Du Trochet and of Professor Amici confirm this opinion. This separation of the vesicles, forming the cellular tissue, can be effected either by simple boiling in water, as was done by Professor Link, or by boiling in nitric acid; but yet the walls of the cells sometimes so intimately adhere to each other that it is impossible to separate them.

When we observe the growth and formation of the cellular tissue in vegetables, we acquire a certainty that it is composed of cells at first insulated, but which, in the progress of their development, become at last more or less united. In fact, in the cellular tissue, there may be seen by means of the microscope, ovate or rounded

bodies, generally of a green colour, but yet exhibiting all possible shades, according to the parietes in which they are observed. It is these corpuscles that give colour to the cellular tissue, whose parietes are always diaphanous. M. Turpin, who in an excellent memoir has again directed the public attention to these corpuscles, has given them the generic name of Globuline. Each grain of Globuline is a small vesicle, in which are subsequently formed other small granules, which growing successively, ultimately burst the vesicle that contains them. Each of them afterwards becomes a small vesicle, in which new granules are developed, that exhibit the same phenomena. It is thus that the cellular tissue, which forms the mass of vegetables, grows and is developed in every direction. M. de Candolle, considering that it is this cellular tissue that gives colour to all the parts of a vegetable, has recently proposed to give it the name of *chromule.*

When they only meet with the resistance occasioned by the presence of the adjacent cells, it is no unusual thing to find these cells possessed of a form which is nearly hexagonal, so that they pretty nearly resemble the cells constructed by bees. But they may be more or less elongated, rounded or compressed, according to the obstacles which are opposed to their free development.

It is even very rare to find them with that regular and hexagonal form, which we have now adverted to. Their parietes are thin and transparent; they all communicate with each other, either by wide openings, or by pores or clefts in their parietes. These pores, which are scarcely visible by means of the most powerful optical instruments, have been seen by Leuwenhoek and Hill; and in our own days M. M. Mirbel and Amici have again admitted their existence. According to many physiologists, and particularly M. M. Rudolphi and Sprengel, the different cells communicate with each other at a point where their parietes are interrupted. But Bernhardi first demonstrated, that the communication between the cells existed only where the pores of their parietes were invisible. The latter opinion is generally admitted at present. Thus it appears very probable, that it is by exudation that fluids pass from one cell into another.

In the woody parts, the cells of the areolar tissue are greatly elongated, and form a species of small tubes which are parallel to each other. Their parietes are opaque and thick; sometimes even, they at last become wholly obliterated. It is to this modification that M. Link has given the name of elongated tissue.

This elongated tissue exists in abundance

in vegetables. It is much more common than the regular cellular tissue, and is composed of small tubes, which are contracted at different distances. At other times they are fusiform, that is to say, gradually smaller at their two extremities. It is to this modification of the cells of the elongated tissue, that M. Du Trochet has given the name of *clostres*. They are in general parallel to each other, more or less opaque, and very abundant in the woody tissue. It sometimes happens, that the cells of the elongated tissue touch one another only at their widest points; whence intervals or empty spaces are found between them. These are the spaces that Hedwig has called vasa revehentia, and Link, Ductus intercellulares. According to the opinion of Professor Amici, these spaces never contain any liquid, but only air; for the great pores of the epidermis, which, as we shall see immediately, when speaking of that membrane, are organs which give passage only to air, are always placed before one of those spaces. When the texture is too compact, and the small tubes too close to exhibit these spaces, neither can there be distinguished any cortical pores. There is moreover another modification of the elongated tissue, which deserves to be mentioned here; I mean the medullary rays or insertions of the stem of

dicotyledonous vegetables; they are very small, elongated, and placed horizontally, instead of being vertical.

The cellular tissue, in its state of native purity, has very little consistence; it is easily torn. Accordingly, in certain vegetables, there are found empty spaces filled only with air, and resulting only from the bursting of the parietes of several cells. These spaces, which have received the name of lacunæ, occur chiefly in vegetables which live in water, and they appear to resist the maceration which those plants would inevitably undergo, by their long continuance in that fluid. M. Amici entertains quite a different opinion from that which we have now stated, respecting the lacunæ. According to him, they do not, as M. Mirbel thinks, result from the laceration of the cells. They are more or less regular spaces, always containing air. Sometimes hairs of a peculiar nature have been observed on their inner surface, in the form of tufts or pencils; these have been seen by M. M. Mirbel and Amici. It is possible to distinguish two species of lacunæ, the one having for an orifice the cortical pores, which communicate with the external air, the others having no external communication. The latter exist particularly in plants which want the porous tubes. In concluding what relates to

the organization of the vesicular tissue, it will be necessary to observe, that it possesses two essential properties; the one is the power of absorbing liquids, the other is its organic contractility. It is by means of these two fundamental properties that we must explain many of the phenomena of vegetable life.

Of the Vascular Tissue.

The vascular or tubular tissue is the second modification of the elementary tissue. Vessels are layers of elementary cellular tissue, rolled up in such a way as to form canals or cells, which are more or less elongated and placed end to end, and whose partitions have often disappeared. The parietes of the vessels are sometimes pretty thick, slightly transparent, and perforated with a great number of openings, by means of which they diffuse into the surrounding parts a portion of the gaseous or liquid fluids which they contain. These vessels are not continuous from the root to the top of the plant, but they frequently anastamose with each other, and ultimately they are changed into areolar tissue.

The principal species of vessels known are seven.

1st. The beaded or moniliform vessels. 2d.

The porous vessels. 3d. The slit vessels or false spirals. 4th. The spirals. 5th. The mixt vessels. 6th. The proper vessels (vasa propria.) 7th. The simple vessels or tubes.

1st. The beaded vessels (pl. 1. fig. 1.) These are porous or punctuated tubes, contracted at different distances, and crossed by partitions which are perforated with holes like a sieve. According to most anatomists, these partitions have no existence. These vessels are chiefly found at the junction of the root and stem, of the stem and branches, &c. They might, in our opinion, be very justly considered as simple cells of areolar tissue, disposed in longitudinal series or lines.

Punctuated vessels (plate 1. fig. 2, 3). These represent cortinuous tubes, exhibiting a great number of opaque points, which others have considered as pores disposed in transverse lines. M. Mirbel has called them porous vessels. They occur in the woody layers of the stem, of the root, and of the branches.

False spirals (pl. 1. fig. 4, 5). Tubes slit in a transverse direction, according to the opinion most generally adopted. These, as well as the spirals, are the principal channels for conveying the sap. By M. de Candolle, they are designated by the name of slit vessels, or striped vessels. They are very abundant in the woody layers of

dicotyledonous vegetables, and in the woody fibres of the monocotyledonous.

4th. The spirals (Pl. 1. fig. 6.) which Malpighi and Hedwig had compared to the respiratory organs of insects, are vessels formed of a transparent silvery layer, rolled spirally on itself, and whose thickened edges touch one another, so as to leave no space between them; but yet in such a manner as not to adhere.* Sometimes, however, the spires of these vessels are never unrolled. It is to this kind of vessel that Link has given the name of *united spiral vessel.* According to Link and Schrader, the layer which is rolled spirally, has a groove on its inner surface. In dicotyledonous plants, they are seen around the pith, and in the monocotyledons they are chiefly in the centre of the woody filaments. The bark and annual layers of wood never contain any. They are sometimes found in the root, and it is also very easy to unrol them in the nerves of the leaves, in the petals, in the filaments of the stamina, &c. The spirals, at their extremities, terminate in cellular tissue, according to Mirbel;

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* They have the greatest possible resemblance to the elastic wires of suspenders.

but according to Du Trochet they end in a sort of cone, which is more or less acute.

Hedwig considered the spiral vessels or tracheæ, which Grew called air vessels, as composed of two parts, namely, of a straight and central tube full of air, which on that account he called a pneumatophorous vessel, and of a tube rolled spirally on the former, and full of aqueous fluid, to which he gave the names of adductor vessel, chyliferous vessel, &c. M. Bernhardi too, has advanced another opinion respecting the structure of spiral vessels. He considers them as formed of a very thin external tube, in which a small silvery layer is rolled spirally in such a manner as to keep its parietes asunder. Lastly, some authors admit, that the spires of the tracheæ are held together by a very thin membrane, which is easily torn when the spiral thread is unrolled. It would follow, from this organization, that, in their natural state, the tracheæ form a continuous tube. The spiral vessels are not always simple. They are sometimes found with double, triple, or even with a very great number of parallel spirals, as may be seen in many of the monocotyledonous plants.

5th. The mixed vessels discovered by Mirbel participate at once in the nature of all the others; that is to say, that they are alternately porous,

slit, or rolled spirally at different points of their extent. Yet M. Amici, who has made a great number of microscopical observations on vegetable anatomy, thinks that the false spiral vessels never become tracheæ. Besides, as he has remarked, these two kinds of vessels occupy different places.

6th. The proper vessels, which are also designated by the name of reservoirs of the proper juices, are short tubes without pores, containing a juice peculiar to each vegetable. Thus in the Coniferæ, they contain resin, in the Euphorbiaceæ a white and milky juice, &c. They are found in the bark, pith, leaves and flowers. They are sometimes solitary, sometimes united in bundles.

7th. The simple tubes are vessels of a variable size, often branched and anastomosing with each other, whose office is to circulate the sap, and whose thin and more or less opaque parietes exhibit no visible pores.

These different species of vessels, to which might be added a great number of other modifications, are often united together in considerable numbers, and constitute long bundles connected by cellular tissue. They then form fibres, properly so called. It is these fibres or bundles of tubes that form the frame work, and as it were the skeleton of most of the leafy organs of vegetables.

On the other hand, the part which is usually soft, and composed essentially of cellular tissue, is called parenchyma, and is observed in fruits, leaves, &c. This term is used in opposition to the word fibre. Every part which is not fibrous, is composed of parenchyma.

It is by being united and combined in various ways, that the parenchymatous and fibrous tissues constitute the different organs of vegetables. In all, in fact, we find by analysis, only these two essential modifications of the fundamental tissue. The seven principal modifications of the vascular tissue differ from each other, not only in their organization and relative situations, but even in the fluids which they contain. In this respect, they may be distinguished into three series.

1st. The sap vessels, or lymphatics in which the sap is circulated. 2d. The vessels containing the proper juice. 3d. The air vessels, in which we never find any thing but air or other elastic fluids.

But the different writers on vegetable anatomy and physiology, are far from agreeing on the class to which the different species of vessels that we have now described, ought to be referred. Thus, for instance, Malpighi, Hedwig, and many other old botanists, considered the spiral vessels

as destined to contain nothing but air. M. Link has defended the same opinion, which he has extended to the porous vessels and false spirals. But according to the observations of M. Mirbel, the existence of air vessels had been called in question, and altogether denied. Thus he considered all the tubes of vegetables as destined solely for the circulation of sap. This opinion, which is generally adopted in our days, has been lately combated by Professor Amici. This able observer says positively, that he has ascertained by observation, that the spirals, the false spirals, the porous vessels, and, in general, all the tubular and cellular organs of vegetables, which have visible holes or slits, never contain any thing but air. When the diameter of these tubes is large enough, this observation can be easily verified by cutting the tubes across; they are then observed to be always empty. If the division be made under water, each of them is seen to present a small air bubble at its orifice.

The openings or pores with which the porous vessels are perforated, are very frequently organized like the pores of the epidermis, that is, they present at their circumference a circular swelling or border. This observation, which is due to M. Mirbel, has been confirmed by M. Amici. From this resemblance the latter draws a conclusion,

which is favourable to his opinion respecting the nature of the fluid contained in these vessels. In fact, as we shall see hereafter, the great pores of the epidermis never give passage to any other than elastic fluids. The air contained in the porous vessels, does not communicate with the external air. M. Amici thinks it is produced in the interior of the vegetable tissue; but its nature is not as yet perfectly known. In woody vegetables, where the air vessels ultimately disappear, their place is occupied by the medullary rays, which perform the same functions. They are, in fact, composed of small tubes placed horizontally, or of porous cells elongated in a transverse direction, which, according to the Professor of Modena, serve to establish a communication between the inner parts of the vegetable and the outer. These tubes or cells never contain any thing but air.

From what has been already stated, we see that there are two principal means of communication between the different parts of the vegetable tissue. In the air cells or tubes, the communication is preserved by means of intermolecular pores or very thin slits, but whose existence can be established, and whose organization can be known by the aid of the microscope. These pores are altogether wanting in the cellular tissue,

properly so called, and in the vessels which we have designated by the name of simple tubes or sap vessels. In that part of the vegetable tissue, the communication takes place, either by a kind of imbibition, or by the intermolecular spaces, which the globules that compose the layers of that tissue, leave between them.

Although the pores which are observed on the parietes of the elongated cells of the moniliform vessels, and of the porous vessels, have been seen and described with minute accuracy by a great number of modern authors, and particularly by M. M. Mirbel and Amici, yet M. Du Trochet, in his Memoir on the Anatomy of the Sensitive Plant, has recently denied their existence. It is upon this assertion that he has founded a system, which we shall here explain in a few words. This observer pretends, that the organs described by M. Mirbel, as pores surrounded by a projecting border, are nothing more than small globular cells, placed in the thickness of the parietes of the areolæ of the cellular tissue, or of the vessels, and full of a green transparent matter. These cells, says the author, in their quality of transparent spherical bodies, collecting the rays of light in a central focus, should appear opaque at their circumference, and transparent in their centre, which would make them appear perfo-

rated. But it seems to us that M. du Trochet is entirely mistaken. The corpuscles which he has examined, and which he has supposed to be the pores described by M. Mirbel, are organs quite distinct from the latter; it is no wonder then that he should not have seen them perforated. They are nothing more than those grains of amylaceous substance, or those small, greenish, glandular bodies, disseminated in great abundance through all parts of the vegetable tissue, to which Turpin has recently given the name of globuline. The denial of M. Du Trochet falls, therefore, of itself to the ground, since his observations relate to an organ which is altogether different.

Believing that the pores of the cellular tissue were cells full of a greenish substance, the able experimenter, whom we are now combating, should have applied that observation to the vessels which had been described as possessing slits or pores. Accordingly he has pretended, that the porous vessels are nothing but tubes with globular greenish cells, disposed in a more or less regular manner, and that the false spiral or slit vessels, have their cells arranged in transverse lines. The author has subsequently examined what is the nature of this greenish matter, and what are its uses. Having tested it by chemical reagents, he has found that it coagulates by nitric

acid, and that alkalies reduce it again to its original state. Now this is precisely the manner in which the cerebral substance of animals is affected by the same reagents. He arrives, therefore, at this conclusion, that this greenish matter is a true nervous system, or rather the scattered elements of a diffused nervous system, which is not collected into one mass, but which presents itself under the aspect of small, scattered, or united points, which he calls nervous corpuscles. This opinion, he says, founded on the analogy of the chemical nature of the globular corpuscles, derives additional strength from observing the intimate structure of the nervous system of certain animals. Thus, in the gastropode mollusca, the medullary substance of the brain is composed of agglomerated globular cells, on the parietes of which there is a great number of ovate or globular corpuscles, which are only very smalls cells, full of nervous medullary substance. The similitude between this organization, and that which we have described in vegetables is perfect, according to M. Du Trochet, and forces us to acknowledge that vegetables are provided with a nervous system.

We are satisfied here with stating the opinions recently advanced by this celebrated physiologist; we shall examine them more particularly, when

speaking of the motility of vegetables, after having studied the functions of leaves.

In order to conclude what relates to the examination of the anatomy of the different constituent and elementary parts of vegetable organization, we must now turn our attention to glands and hairs, considered in reference to their anatomical structure.

Glands are peculiar organs which are observed on almost all the parts of a plant, and which are destined to separate from the general mass of the humours some particular fluid. In their uses and their structure, they have the greatest possible analogy to those of animals. They appear to be formed of a very delicate cellular tissue, in which a great number of vessels are ramified. But this name has been also given to vesicular bodies, which are often transparent, and placed in the substance of organs, and are full of a volatile oil, which has been probably secreted in their interior. Their peculiar form and structure are very various, and have caused them to be distinguished into several species. Thus there are,

1st. Miliary glands. These are very small and superficial. They appear under the form of small round grains, disposed in regular series, or scattered without order on all parts of the plant which are exposed to the air.

2d. Vesicular glands. These are small reservoirs, full of essential oil, and lodged in the herbaceous integument of vegetables. They are very distinct in the leaves of the myrtle and of the orange, and appear under the aspect of small transparent points, when those leaves are placed between the eye and the light.

3d. Globular glands. Their form is spherical; they adhere to the epidermis only by a point. They are observed particularly in the Labiatæ.

4th. Utricular glands or ampullæ. They are full of a colourless fluid, as in the Ice plant.

5th. Papillary glands. They form a species of paps or papillæ, which have been compared to those of the tongue. They occur in many of the Labiatæ, for example in the *satureia hortensis.*

Lastly, there are lenticular glands, some sessile, others borne upon hairs. The tribe of the Drupaceæ in the family of the Rosaceæ, the families of the Passifloræ and many of the Leguminosæ, and of the Malvaceæ, bear on their petioles or on the disc of their leaves, glands of very various forms, which often furnish excellent characters for distinguishing species. Hairs are filamentous organs of greater or less delicacy, which serve for the purpose of absorption and of exhalation in vegetables. There are few plants without them. They are observed chiefly on

those which grow in dry and arid situations. In this case, they have been looked upon by some botanists as serving to multiply, and to extend the absorbing surfaces of vegetables. Accordingly, they are not found on very succulent plants, such as the thick leaved, or those which live habitually in water. Hairs, in many cases, appear to be the excretory ducts of vegetable glands. In fact, they are frequently inserted on a papillary gland. Is it not known that the hairs of the urtica urens and urtica dioica (of the small and the great nettles) do not produce blisters on the skin, except when, by piercing it, they pour in at the same time an irritating fluid, secreted by the glands on which they are implanted, inasmuch as when, by drying, this fluid is evaporated, the hairs of the nettle no longer produce the same effect?

Hairs are distinguished into the glanduliferous, the excretory, and the lymphatic. The first are either immediately applied to a gland, or surmounted by a small, peculiar, glandular body, as in the white fraxinella (dictamnus albus;) the second are placed on glands of which they appear to be the excretory ducts, destined to pour out the secreted fluids. Lastly, the third are only a simple prolongation of a cortical pore.

The form of the hairs presents a great num-

ber of varieties. Thus there are the simple, the branched, the awlshaped, and the capitate. Others are hollow and crossed at different places by horizontal partitions. In the Malpighiaceæ they have the form and horizontal position of a turnip seed.

They are sometimes solitary, or else collected into clusters, stars, &c.

As to their disposition upon a part (which is known by the name of pubescence) we shall treat of it, when speaking, under that head, of the modifications of the stem.

We have now considered the anatomical structure of vegetables, we have penetrated into their texture, and we have separated and analyzed the rudiments or elementary parts of their organization. Let us now consider the vegetable viewed as a whole, let us see what are the parts that compose it in its perfect state of development.

A vegetable in its highest degree of development and perfection, presents the following organs for our consideration :

1st. The root, or that part which ending it below, usually sinks into the earth, where it fixes the vegetable, or floats in water, when the latter swims on the surface of that fluid.

2d. The stem, which growing in the opposite direction to the root, always grows upwards from

the moment when it begins to be developed, is covered with leaves, with flowers, and with fruit, and is divided into large branches and into small ones.

3d. The leaves, or those species of membraneous appendages, which are inserted on the stem and its divisions, or grow immediately from the neck of the root.

4th. The flowers, that is to say very complicated parts, containing the organs of reproduction in two peculiar integuments, destined to contain and to protect them.

5th. The pistil or the female sexual organ, either simple or multiple, almost always occupying the centre of the flower, is composed of a lower hollow part, called ovary, fit to contain the rudiments of the seeds or the ovules, of a glandular part usually situated at the top of the ovary, destined to receive the impression of the male organ, and which is called stigma, and sometimes of a style, a kind of filiform prolongation from the top of the ovary, which if present, supports the stigma.

6th. The stamina or the male sexual organs, essentially composed of an anther, a species of small membraneous bag, usually two-celled, containing within it the substance which is destined to produce fecundation, or the *pollen*. In general

the anther is borne on a filament of variable length. In this case, the stamen is formed of a filament or accessory part, and of an anther or essential part.

7th. The corolla, or inner integument of the flower, often painted with the richest colours, sometimes formed of a single piece, and then said to be a monopetalous corolla; at other times polypetalous, that is composed of a more or less considerable number of distinct pieces, each of which bears the name of petal.

8th. The calyx or outer integument of the flower, of a leafy nature, usually green, composed of a single piece, and, in this case, called monosepalous, or formed of many distinct pieces which are called *sepals,* in which case it is called polysepalous.

9th. The fruit, that is to say the ovary developed and containing the fecondated seeds, is composed of the pericarp and the seed.

10th. The pericarp, of very variable form and consistence, is the developed and full grown ovary, in which were contained the ovules which are now become seeds. It is composed of three parts, namely, of the epicarp or outer membrane, which defines the form of the fruit, of the endocarp or membrane which lines its inner simple or multiple cavity, and lastly, of a parenchymatous

part, situated and contained between these two membranes, and which is called sarcocarp. The sarcocarp is particularly well developed in the fleshy fruit.

11th. The seeds contained in a pericarp, are attached to it by a peculiar support, formed of vessels which convey their nutriment. This support is the *trophosperm* or *placenta.* The point on the surface of the seed to which the trophosperm is attached, is called *hilum* or *umbilicus.* Sometimes the trophosperm, instead of stopping at the circumference of the hilum, is more or less continued over the seed, so as even to cover it completely. It is this peculiar prolongation that has received the name of *arillus.*

The seed is essentially composed of two distinct parts, the episperm and the kernel.

12th. The *episperm* is the proper membrane or integument of the seed.

13th. The *kernel* is the body contained in the episperm.

The kernel is essentially composed of the *embryo*, that is to say, of that part which placed in a proper situation, tends to be developed and to produce a vegetable perfectly similar to that which has given it birth. Besides the embryo, the kernel sometimes contains another body, also of a variable nature and consistence, to which the

embryo is applied, or within which it is entirely concealed. This body has received the names of *endosperm*, of *perisperm*, and of *albumen*. The embryo is the essential part of the vegetable. It is to contribute to its formation and perfection, that all the other organs of vegetables seem to have been formed. It is composed of three parts; one inferior or the radicular body is that which in germinating gives rise to the root; another superior, or the gemmule, is that which in its development produces the stem, the leaves and the other parts which are to vegetate above ground. Lastly, an intermediate and lateral part, which is the cotyledonary body, is either simple or divided into two parts, which are called cotyledons. Hence the division of vegetables, provided with an embryo into two great classes, the monocotyledons, or those whose embryo has but one cotyledon, and the dicotyledons, or those whose embryo presents two cotyledons.

Such is the most general and the most complete organization of vegetables. But we cannot expect to find always united on the same plant, the different parts which we have now rapidly enumerated. Many of them are very often wanting on the same vegetable. It is thus, for instance, that the stem is sometimes so little developed, as to appear not to exist, as in the plantain in the

primrose; that the leaves do not exist in the dodder; that there is no corolla in all the monocotyledons, that is, that there is but a single integument around the sexual organs; that this single integument sometimes disappears as in the willow, &c.; that often even the flowers contain but one of the two sexual organs, as in the hazel, where the stamens and pistils are contained in distinct flowers; or lastly, that the two sexual organs sometimes wholly disappear, as in the viburnum opulus, hortensia, &c.

Yet in the different cases which we have now cited, this absence of certain organs is only accidental, and has no marked influence on the rest of the organization, insomuch that the vegetables which want those organs do not deviate sensibly, either in their external characters or in their mode of vegetation and re-production from those which possess them. But there is a certain number of other vegetables, which by the constant privation of sexual organs, by their external forms, their mode of vegetation and reproduction, differ so much from the other known plants, that they have been at all times separated from them in order to form a distinct class. It is to these vegetables that Linnæus has given the name of *cryptogamic*, that is to say, of plants with concealed or invisible sexual organs, in order to dis-

tinguish them from other known vegetables, whose sexual organs are apparent, and which have therefore received the name of *phanerogamic.* The cryptogamics, which are more properly called *agamics,* inasmuch as they have no sexual organs, are very numerous. They constitute nearly the seventh or eighth part of the 50,000 vegetables which are known at present. As they have no seeds, and therefore neither embryo nor cotyledons, they are also called inembryonate or acotyledonous. Thus then, we are led to find in vegetables three fundamental divisions, taken from the embryo, namely :—

1st. The *inembryonate* or *acotyledonous,* that is to say, plants in which are not observed either flowers properly so called, nor therefore any embryo or cotyledons; such are the ferns,* the mosses, the hepaticæ, the lichens, the fungi, &c.

2d. The *embryonate* or phanerogamic plants, provided with very evident flowers, with seeds and with an embryo, they are distinguished into :

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* Some authors, but in our opinion very improperly, have placed the ferns among the plants possessed of monocotyledonous embryos. In fact, it is the clearest thing possible, that these plants are not reproduced by means of true seeds, but simply by peculiar bodies, a species of little bulbs, which are also observed on other vegetables, and which have received the name of sporules.

Monocotyledons, or those in which the cotyledonary body of the embryo is of a single piece, and produces a single leaf by germination, such are the grasses, the palms, the lilies, &c.

And into *dicotyledons*, or those whose embryo having two cotyledons, produce two leaves by germination; for example, the oak, the elm, the labiate plants, the cruciform, &c.

The number of the dicotyledonous plants is greater than that of the monoctyledonous and acotyledonous united. Such are the great fundamental divisions established in the vegetable kingdom. We have thought it right to explain them here concisely, and to give a general idea of them, because, in the course of this work we shall be often obliged to use the words acotyledons, dicotyledons, and monocotyledons, which, if not previously defined, would have necessarily arrested the natural course of ideas. And here we are compelled to admit, that the course of the natural sciences is not so exact as that of the physical and mathematical. In the exposition of the fundamental facts and ideas which belong to natural history, we cannot always proceed strictly from the known to the unknown. It is often impossible to avoid passing by certain intermediate ideas not yet defined, and to suppose that those for whom we write have a knowledge

which, happily, they almost always possess. We have, as far as possible, tried to remedy this inconvenience in the exposition of the elementary notions of Botany, with which we have presented our readers. We have here endeavoured to state facts in their greatest degree of simplicity, in order that even those who as yet know nothing of this science, may easily pursue the successive development into which we are about to enter on the subject of the different organs of vegetables. The organs of vegetables are divided into two classes:

1st. Accordingly as they serve for nutrition, that is to say, for absorbing in the bosom of the earth or in the atmosphere, nutritious substances fit for their development; they are then called *organs of nutrition* or of *vegetation*, such are the root, the stem, the buds, and the leaves, &c.

2d. Accordingly as they serve for the reproduction of the species, they are called *organs of reproduction* or of *fructification*. The most natural order of ideas, no doubt, would have been to commence by studying the organs of the plant in the seed, which contains them all in the rudimental state, and afterwards to follow their ulterior progress to their most perfect state of development; but the organization of the seed being unquestionably the most difficult subject of Bo-

tany, that upon which there still remains the greatest doubt and obscurity, it has appeared to us, that it would be first necessary to accustom our readers to more simple ideas and facts, in order to lead them thus gradually to the most complex parts of vegetable organization.

FIRST CLASS.

THE ORGANS OF NUTRITION OR OF VEGETATION.

In the foregoing Introduction, we have divided the organs of vegetables into two classes, according to the offices which they perform. In the first class we place the organs of nutrition or of vegetation; in the second, those of re-production or of fructification. The organs of nutrition are all those to whose care is intrusted the individual preservation of vegetables. They are the roots, stems, leaves, stipules, and some of these organs degenerated, such as spines, prickles, and tendrils.

These organs have a common object, the maintenance of life in the vegetable. In fact, the root, buried in the earth, absorbs a part of the fluids destined for nutrition and repair; the stem transmits these fluids into all points of the vegetable, while the leaves spread out in the midst of the atmosphere, perform in it the same office as the roots in the earth, and seem at once as organs of absorption and of exhalation. We see by this short statement of their functions, that these different organs are all subservient to the same end;

that they nourish the vegetable and contribute to its vegetation, that is to say, to the development of all its parts.

CHAPTER I.

OF THE ROOT.*

The name of *root* is given to that part of the vegetable, which occupying its lower extremity, and almost always concealed in the earth, grows constantly in a direction opposite to that of the stem, that is to say, descends perpendicularly in the earth, while the latter rises towards the heavens.

A character of the root no less remarkable is, that it never turns green (at least in its tissue) when exposed to the action of air and light, whereas all the other parts of vegetables acquire that colour in the same situation.

With the exception of some Tremellæ and of certain Confervæ, which immersed in water or vegetating on its surface, absorb the materials of nutrition at every point of their extent; all other vegetables are provided with roots, which seem

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* Radix, Lat. ῥίζα Greek.

to fix them in the soil and to draw from it a part of their nourishment.

Roots, as we have observed, are most usually implanted in the soil. This is actually the case with respect to the greatest number of vegetables; but there are others which, living on the water's surface, exhibit roots floating in the midst of that fluid, as may be observed in certain water tares. Most aquatic plants, such as buckbean, water lily, hooded milfoil,* are possessed of two species of roots. The one species sunk in the earth, fix the plant to the soil, the other usually proceeding from the base of the leaves, are free and floating in the midst of the water.

Other plants vegetating on rocks, such as lichens; upon walls, such as common wall flower, the snap dragon; the red valerian; on the trunks or roots of other trees, such as ivy, certain tropical species of orchis, most of the mosses, broom-rape, the hypocyst, insert their roots in them, and being true parasitical plants, derive from them the materials of their nutrition and live at their expense. The clusia rosea, a sarmentaceous shrub of South America, the sempervivum arboreum, the Indian corn, the mangrove, and some

* The filamentous parts which most botanists have taken forroots in the hooded milfoil, are nothing but floating roots.

exotic figs, besides the roots which terminate them below, produce others from different points of their stem, which often descend from a considerable height, and sink into the earth. These supernumerary roots have received the name of adventitious roots, and a remarkable fact respecting them is, that they do not begin to grow in diameter until their extremity has reached the soil, and draws from thence the materials of its growth.

We must not confound roots, as has been often done, with certain subterraneous stems, which creep horizontally under the earth, as in the iris germanica, Solomon's seal, &c. Their direction alone would be almost sufficient to distinguish them, if other characters also did not assist in making known to us their true nature. (See what we say of them in the following chapter, when speaking of the subterraneous stem or stock root.)

Different parts of vegetables are capable of producing roots. Cut off a willow branch, or the branch of a poplar, plant it in the earth, and in the course of some time its lower extremity will be covered with radicles. The same will happen, when both the extremities are planted in the soil; each of them will be fixed in it, by the means of roots which are produced from them. In grasses, particularly in Indian corn, the lower knots of

the stem sometimes give out roots which descend and sink into the earth. It is upon this property of the stem, and even of the leaves of many vegetables, of producing new roots, that are founded the theory and practice of propagating by slips and layers, a means of multiplication which is much employed in their culture.

There is great analogy of structure between the roots which a tree shoots into the earth, and the branches which it spreads out in the air. The principal differences observed between these two organs depend chiefly on the different mediums* in which they are developed.

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* It has been said that when a young tree is inverted, so as to have its branches buried in the earth and its roots in the air, the leaves are changed into roots, and the roots into leaves. This is not the fact, or at least the explanation given of it is incorrect. In truth the leaves are no more changed into roots than the roots into leaves. But when they are placed under the earth, the buds situated in the axilla of the leaves, instead of producing young branches or leafy scions, are elongated, blanched, and become radical fibres, while the latent buds of the roots, which are destined annually to renew the tufts of radical fibres, being placed in the other medium, are expanded into leaves. We have also a striking example of this tendency of the latent buds of the root to change into leafy branches when placed in the air, in those shoots which sprout up around trees which have creeping roots, such as the acacia, the poplar, &c.

The roots of certain trees, at different distances, produce a species of cones or excrescences of a loose, soft wood, quite naked and standing above ground, which are designated by the name of exostoses. The deciduous cyprus of North America (taxodium distichum) furnishes the most remarkable example of them.

The root, considered in its whole and in a general way, may be divided into three parts. 1st. The *body* or middle part, of various forms and consistences, sometimes more or less swelled, as in the turnip, the carrot. 2d. The *collar* or *life knot*, that is, the point or line of demarcation which separates the root from the stem, and from which springs the bud of the annual stem, in perennial roots. 3d. The *radicles:* these are the more or less delicate fibres, which usually terminate the root at its lower extremity.

A. According to their duration, roots have been distinguished into annual, biennial, perennial, and woody. *Annual* roots belong to those plants which in the course of one year are developed, bear fruit, and perish; such as wheat, larkspur (delphinium consolida,) common red poppy (papaver rhæas,) &c.

Biennial roots are those of plants which require two years to come to maturity. During the first year, biennial plants usually produce nothing but

leaves; in the second year they perish, after having flowered and produced fruit, as the carrot, &c.

The name of *perennial* roots has been given to those which belong to woody plants, and to those, which during an indefinite number of years send forth herbaceous stems, which annually flourish and decay, while the root lives for several years; such are those of asparagus, of the asphodels, of lucern, &c.

This division of vegetables into annuals, biennials, and perennials, according to the duration of their roots, is subject to vary under the influence of divers circumstances. The climate, temperature, and situation of a country, and even cultivation, influence in a singular degree the duration of vegetables. It is no uncommon thing to see annual plants vegetate for two years, and even more, if they are placed in a suitable soil, and protected from the cold. Thus the mignonnette, which, with us, is only an annual plant, becomes perennial in the sandy deserts of Egypt. On the contrary, perennial and even woody plants of Africa and of America, become annuals, when transplanted into northern climates. The marvel of Peru (Nyctago hortensis) and cobœa, are perennial in Peru and die annually in our gardens. The castor oil plant, which in Africa

forms woody trees, is annual in our climate, yet it again resumes its woody character when placed in a proper exposure. While botanising in the vicinity of Villefranche, on the shores of the Mediterranean, in September 1818, I discovered on the mountain which protects the arsenal of that city to the south, a small wood composed of castor oil plants in the state of trees. Their trunk is woody and hard. The highest is about five and twenty feet, and presents the appearance of a Plane tree. It is true, however, that the situation of Villefranche, exposed to the south and defended from the west winds by a chain of hills of considerable elevation, approaches it very much to the climate of certain parts of Africa.

In general, all perennial exotic plants, whose seeds can produce individuals that flower the first year in our climate, become annuals. This is what happens to the castor oil plant, the cobœa, the marvel of Peru, &c.

Woody roots differ from perennial roots only in their more solid consistence, and in the permanency of the stems which they support; such are those of trees and shrubs.

B. According to their form and structure, roots may be divided into; 1st, The vertical (radix perpendicularis.) 2d, The fibrous (radix fibrosa.)

3d, The tuberiferous (radix tuberifera.) 4th, Bulbiferous (radix bulbifera.)

1st. The vertical roots are those which sink perpendicularly in the earth. They are simple and without any sensible divisions, as in the radish, the carrot; branched as in the ash and Italian poplar, &c. They belong exclusively to dicotyledonous vegetables. (See Pl. 2. fig. 1, 2, 3, and 4.)

2d. The fibrous root is composed of a great number of fibres, sometimes simple and slender, at other times thick and ramified. Such is that of most of the palms. It is seen only in monocotyledonous plants. I call those tuberiferous roots which exhibit on different points of their extent, sometimes at their upper part, at other times in their middle or at the extremities of their ramifications, tubercles which are more or less numerous. These tubercles or fleshy bodies, which have been long improperly considered as roots, are only masses of amylaceous fecula, which nature has, in a manner, kept in store, to serve for the nutrition of the vegetable. Accordingly, true tubercles are never seen in annual plants; they belong exclusively to the perennial; such are those of the potatoe, of the Jerusalem artichoke, of the orchis tribe, of cer-

tain species of Convolvulus.* (See Pl. 2. fig. 5 and 6.)

4°. The bulbiferous root is formed of a species of thin flat tubercle, which is called a plate or disc, producing a fibrous root from its under surface, and supporting on its upper surface a bulb or an onion, which is nothing but a particular kind of bud, composed of a great number of scales or tunics which are applied to each other; for example, the hyacinth, the lily, the garlick, and in general all the plants which are called bulbous. (See Pl. 2. fig. 8 and 9.) Such are the principal modifications which the root exhibits in reference to its peculiar structure. We must confess how-

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* The point of view under which I here examine tubercles, differs from that under which they are usually considered. So far from being roots, as most authors have described them, we agree with Sprengel in viewing them as a species of subterraneous buds in perennial plants, to which nature has confided the care of preserving the rudiments of the stem. The only peculiarity of tubercles considered in this light is, that the young stem, instead of being protected by close and numerous scales, is surrounded by a dense fleshy body, which serves not only to protect it during winter, but also supplies it in spring with the first materials of its growth and nutrition. They might also be considered as subterraneous stems, which are short and fleshy, and the eyes which they contain might be viewed as buds.

ever, that these differences are not so well marked as we have represented them.

Here, as well as in her other works, nature does not conform with servility to our systematic divisions. She sometimes causes to disappear by insensible shades those differences, which we at first thought so constant and so well established. All the roots which cannot be referred to one of the four principal modifications which we have now described, retain the general name of roots.

The tufted part of roots, or that which is formed of more or less delicate fibres, shall be more abundant and better developed as the vegetable grows in a looser soil. When by accident, the extremity of a root meets with a stream of water, it grows long, divides into capillary and branched fibrils, and constitutes what gardeners know by the name of fox's tail. This appearance, which may be produced at pleasure, explains how it happens that aquatic plants have the most highly developed roots.

Next to these general considerations on the structure of roots, we must here describe the principal modifications which this organ undergoes in its consistence, its form, and its other external characters.

C. With respect to its consistence, the root is fleshy, when being manifestly larger and thicker than the base of the stem, it is at the same time

more succulent; such is that of the carrot, the turnip, &c.; on the contrary it is woody, when its parenchyma being more solid, approaches more or less to the hardness of wood. This is what is observed in most of the woody vegetables.

D. The root may be simple (simplex,) that is to say, formed of a tapering vertical body, which is perfectly undivided, as the beet root, the parsnip, the radish, &c. At other times it is branched (ramosa) or divided into more or less numerous and delicate ramifications, always of the same nature with itself; such is that of most of our forest trees, of the oak, of the elm, &c.

E. Considered as to its direction, the root may be vertical, as that of the carrot, of the radish; oblique, for example, that of the iris; and lastly, it may be situated horizontally under the earth, as in the rhus radicans, the elm, &c. Very often these three positions are found united in the different ramifications of the same root.

F. The most remarkable varieties of form are the following:

1°. The fusiform or spindle shaped (fusiformis,) when it is long, smaller at both extremities, and larger in the middle, as the radish, (Pl. 2. fig. 3.)

2°. Napiform or top shaped (napiformis,) when it is simple, round, and swelled at its upper part,

small below, and suddenly terminating in a point: the white radish, the turnip, &c. (Pl. 2. fig. 2.)

3°. The conical (conica,) that which exhibits the form of an inverted cone: the red beet, the parsnip, the carrot, (Pl. 2. fig. 4.)

4°. The round or nearly round (subrotunda,) as in the earth nut (Bunium flexuosum,) &c.

5°. The twin (didyma, testiculata,)* when it presents one or two round or ovate tubercles, as in the orchis militaris, maculata, &c. (See Pl. 2. fig. 5 and 6.)

The twin root is called palmate (palmata) when the two tubercles are divided nearly to the middle of their substance into divergent lobes, like the fingers of the hand; Ex., orchis maculata, (Pl. 2. fig. 6.)

Digitate (digitata) when the tubercles are divided nearly to their base, as in satyrium albidum. According to this form of the twin root, Linnæus has divided the species of the genus orchis into three sections.

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* In the twin root, one of the tubercles (Pl. 2. fig. 5. a.) is firm, solid, and somewhat larger than the other; it is that which contains the rudiments of the stem, which is to grow in the ensuing year; the other, on the contrary, being soft, wrinkled, and smaller, contained the germ of the stem which has been last developed, and on whose growth it expended the greater part of its amylaceous fecula.

6°. Knotted or filipendulous (nodosa,) when the ramifications of the root present at different intervals knots,* or swellings which give it the appearance of beads. This is what is observed in the drop wort and in the avena præcatoria.

7°. Granulated (granulata,) M. De Candolle so calls the root, which presents a mass of small tubercles, containing buds capable of reproducing the plant, without being surrounded with cellular tissue full of amylaceous fecula; for example, that of the saxifraga granulata.

8°. Fasciculated (fasciculata) when it is formed by the union of a great number of radicles, thick, simple, or somewhat branched, like that of the asphodels, of the ranunculi.

9°. Jointed (articulata,) that which at different distances exhibits joints, for example, the hedge hyssop.

10°. Contorted (contorta,) when it has different curvatures in various directions, as that of the bistort.

11°. A capillary root is that which is formed of very delicate capillary fibres, as most of the grasses, wheat, barley, &c.

12°. Hairy (comosa,) when the capillary fila-

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* These knots ought never to be confounded with true tubercles, which always contain the rudiments of new stems.

ments are branched and very close, as in the heath.

With respect to the anatomical structure of the root, we shall not give an explanation of it till after that of the stem, as these two organs have in that respect a very great resemblance.

The Uses of Roots.

The uses of roots have reference either to the vegetable itself, or to its applications to domestic economy, to the arts and to medicine.

With respect to the vegetable itself, the roots serve, 1st, To fix it in the soil, or on the body on which it is to live. 2d, To derive from thence a part of the materials necessary for its growth.

The roots of many plants appear to perform only the first of these two functions. This is what is particularly observed in the thick and succulent plants, which absorb by all points of their surface the substances fit for their nutrition. In this case their roots serve only to fix them in the soil. Every one knows the magnificent Cactus Peruvianus, which grows in the green house belonging to the Museum of Natural History. This vegetable, which is of extraordinary height, with great vigour and surprising rapidity, shoots forth enormous branches; yet its roots are en-

closed in a box, which scarcely contains three or four cubic feet of earth, which is never renewed and never watered.

The roots of plants are not always proportional to the strength and magnitude of the trunks which they support. The palms, and pines whose trunk sometimes attains to the height of more than one hundred feet, have short roots, which sink to an inconsiderable depth in the earth, and therefore attach them but feebly to the soil. Herbaceous plants, on the contrary, whose weak and slender stems die annually, have roots whose length and size are very considerable, compared with those of the stem, as may be observed in the liquorice, the lucerne, the Ononis arvensis, (which on account of the tenacity and depth of its roots, has been called rest harrow.)

Roots also perform the office of absorbing from the earth the substances which are to serve for the growth of the vegetable; but all the points of the root are not engaged in this office. It is only by the extremity of their minutest fibres that absorption is effected. Some say that they are terminated by small vesicles or spongioles, more or less enlarged; others by a species of open mouths. But whatever may be their structure, it is proved that the extremities alone perform the office of absorption.

There is no experiment more easily tried than

that by which the truth of this fact is clearly established. If we take a radish or a turnip, and immerse it in water by the extremity of the radicle which terminates it, it will shoot out leaves and will vegetate. If, on the contrary, it be immersed in the water, so as that its lower extremity be not contained in it, it will not exhibit any signs of development.

The roots of certain plants appear to excrete a peculiar matter, which varies in the different species. Du Hamel tells us, that having caused some old elms to be rooted up, he found the soil surrounding the roots of a deeper colour and more unctuous than the rest. This unctuous, fatty matter was the product of a kind of excretion from the roots. To this matter, which, as we have observed, is peculiar in each species of vegetables, is attributed the antipathies and sympathies which certain vegetables have for each other. In fact it is well known that certain plants, in a manner, seek one another, and live constantly near each other. Such are called social plants ; while, on the contrary, others seem incapable of growing together in the same place.

It has been remarked that roots have a marked tendency to grow in the directions of veins of good soil, and that they are often extended considerably in order to reach the places where the soil is looser and more substantial.

They then begin to grow with more vigour and rapidity. Du Hamel states, that wishing to protect a field of excellent soil from the roots of a row of elms, which were extending in that direction, and wasting a part of it, he caused a deep trench to be sunk along that row of trees, so as to cut the roots which were stretching into the field. Soon, however, the new roots having reached one side of the ditch, bent downwards along its side to the bottom; there they took an horizontal direction, and afterwards ascended at the opposite side, along the acclivity, and again they extended into the plain. The roots of all trees have not the same power of penetrating the hard soil. Du Hamel has made the observation, that a vine root had deeply penetrated into a very hard soil, while an elm root had been arrested by it, and compelled to change its course.

The root, as we have already observed, has a natural and invincible tendency to move towards the centre of the earth. This tendency is particularly remarked in this organ, when first it begins to grow, during the germination of the embryo. At a more advanced period, it is less manifest, although it always exists, particularly in roots which are simple, or in the body of those which are branched; for very often it is not observed in the lateral ramifications of the root.

Whatever may be the obstacles which are op-

posed to this natural tendency of the radicle, it is able to surmount them. Thus, place the germinating seed of a bean or of a pea in such a manner that the cotyledons shall be in the earth, and the radicle in the air ; you shall soon find the radicle curve downwards to the earth, in order to sink into it. Various explanations have been proposed of this phenomenon. Some have said, that the root has a tendency to descend, because its fluids are less elaborated, and therefore heavier than those of the stem. But this explanation is contradicted by facts. For do we not see in certain exotic vegetables, such as the clusia rosea, &c. roots grow from the stem at a very considerable height, and descend perpendicularly in order to sink into the earth? Now, in this case, the fluids contained in the air roots, are the same with those which circulate in the stem, and yet those roots, instead of mounting upwards like the latter, descend in the opposite direction towards the earth. It cannot therefore be the different specific gravities of the fluids that give them this tendency towards the centre of the earth.

Others have imagined that they discovered the cause in the avidity of roots for moisture, which is greater in the earth than in the atmosphere. Du Hamel, wishing to satisfy himself of the truth of this explanation, caused some seeds to germinate between two humid sponges suspended in the air.

The roots, without inclining to either of the sponges, which were perfectly humid, glided between both, and appeared suspended beneath them, being directed towards the earth. Moisture, therefore, is not the cause by which roots are attracted towards the centre of the earth.

Can it be the earth itself, either by its nature or its magnitude? This explanation also, is contradicted by experiment. M. Du Trochet filled with earth a box, whose bottom was perforated with many holes. In these holes he placed some germinating seeds of French beans, and suspended the box in the open air at the height of about twenty feet. In this manner, he says, the seeds placed in the holes made in the bottom of the box, received the influence of air and light from below upwards; the humid earth was placed above them. If the humid earth be the cause which determines the direction of the radicle, in this case it ought to be seen ascending into the earth which lay above it, and the stem, on the contrary, ought to descend into the atmosphere placed below it; this, however, did not happen. The radicles of the seeds descended into the atmosphere, where they soon perished, while the plumules mounted upwards into the earth.

Mr. Knight, a celebrated English naturalist, wished to ascertain, by experiment, if this ten-

dency could be destroyed by a rapid circular motion, communicated to germinating seeds. He accordingly, fixed some seeds of French bean in the nave of a wheel, kept constantly moving in a vertical plain by a stream of water, the wheel performing one hundred and fifty revolutions in a minute. The seeds, which were placed in some moss kept constantly moistened, soon began to germinate. All the radicles were directed towards the circumference of the wheel, and all the gemmules towards its centre. By each of these directions, the gemmules and radicles obeyed their natural and opposite tendencies.

The same naturalist made a similar experiment with a wheel moving horizontally, at the rate of one hundred and fifty revolutions in the minute. The results were similar; that is to say, all the radicles were directed towards the circumference, and the gemmules towards the centre, but with an inclination of ten degrees of the former towards the earth, and of the latter towards the heavens. These experiments were repeated by M. Du Trochet, and had the same results, except that in the second, the inclination was not so considerable, and that the radicles and gemmules were nearly horizontal.

From the different experiments above mentioned, it clearly follows, that the roots are directed towards the centre of the earth, not be-

cause they contain a less elaborated fluid, nor because they are attracted to it by the moisture or even the nature of the earth, but by a spontaneous movement, an interior force, a kind of subjection to the general laws of gravitation.

But although it may be said that this law of the tendency of roots towards the centre of the earth is general, yet some vegetables seem to be exempt from it; such are in general all parasitical plants, and the misseltoe (viscum album) in particular. This singular plant, in fact, shoots out its radicle in whatever situation chance may place it. Thus when the seed, which is enveloped in a thick and viscid glue, adheres to the upper part of a branch, its radicle, which is a kind of hollow tubercle in the shape of a horn, is then perpendicular to the horizon; if, on the contrary, the seed be applied to the under surface of the branch, the radicle will be directed towards the heavens, or if situated on the lateral surfaces, the radicle will be directed laterally. In a word, in whatever situation the seed may be placed upon the branch, the radicle will always assume a direction perpendicular to its axis.

M. Du Trochet has tried a great many experiments on the germination of this seed, in order to ascertain the direction of its radicle. We shall here mention the most interesting of them. This seed, which finds in the viscid substance which

covers it, the first materials of its growth, germinates, and is developed not only on wood either living or dead, but also upon stones, glass, and even upon iron. M. Du Trochet has caused it to germinate on a cannon ball. In all these cases, the radicle was invariably directed towards the centre of those bodies. These facts prove, as has been observed by the ingenious experimenter, that the embryo of the misseltoe does not direct its radicle towards a medium fit for its nutrition, but that the radicle obeys the attraction of the bodies to which the seed adheres, whatever may be their nature. But this attraction is only the remote cause of the tendency of the misseltoe root towards the bodies in question. The true cause is an internal spontaneous motion, executed by the embryo, and produced by the attraction exerted on its radicle. M. Du Trochet fastened a germinating seed of misseltoe to one end of a copper needle, moving on a pivot like that of a mariner's compass, a small ball of wax being placed at the opposite end to serve as a counterpoise to the seed. Matters being thus arranged, M. Du Trochet moved laterally towards the radicle a small plate of wood, so as to be at the distance of nearly half a line. This apparatus was afterwards covered with a glass receiver, so as to guard against disturbance from external causes. After the lapse of five days the stem of the em-

bryo was bent, and its radicle directed towards the small plate that was near it, without any change being produced in the position of the needle, notwithstanding its extreme mobility on the pivot. Two days after, the radicle was directed perpendicularly towards the plate with which it came in contact, without producing the slightest derangement of the needle which bore the seed.

The radicle of the misseltoe exhibits another tendency, which is very constant; it is that of shunning the light. Let the seeds of the misseltoe be made to germinate on the inner surface of a glass window, and you shall see all the radicles directed towards the interior of the apartment, as if in search of darkness. Take one of the germinating seeds, and apply it to the outside of the glass, its radicle shall be in close contact with it, as if it had a tendency towards the interior of the apartment, in order to shun the light.

Many roots are usefully employed in domestic economy as articles of food. Thus carrots, turnips, parsnips, salsifies, and many other roots, are too universally employed to require that we should enter into any details respecting them. It is from the tubercles of a great number of the orchis tribe, duly prepared, that we obtain salep.

By a process which chemistry has brought to

a high degree of perfection, a sugar is extracted from beet, that may be substituted with advantage for that which is imported at great expence from the colonies. Certain plants which have the power of shooting out roots that ramify, and extend to great distances, are used for the purpose of consolidating moving soils. Thus in Holland, and around Bourdeaux, the Carex arenaria is planted on the downs and on the banks of canals, for the purpose of fixing and consolidating the soil.

The hippophae rhamnoides, or sallow thorn, the Spanish broom, &c. are planted in many other countries for a similar purpose.

Several roots are used with advantage in dying, such are those of madder, of alkanet, of turmeric, &c.

With respect to the medicinal uses of roots, it is well known that the healing art is indebted to them for some of the most valuable medicines.

CHAPTER II.

OF THE STEM (Caulis L.)

We have seen that the root tends in general to sink towards the centre of the earth. The stem, on the contrary, is that part of the plant,

which growing in a direction opposite to that of the root, seeks the air and light, and serves as a support to the leaves, the flowers, and the fruit, when the plant possesses them. All phanerogamic vegetables have a stem, properly so called. But sometimes this stem is so little developed, is so very short, that it appears not to exist. Plants which are so circumstanced, have been said to have no stem, or to be *acaules;* such are the cowslip, the hyacinth, and many others. We must not confound the true stem with the scape and the radical peduncle. The scape (scapus) is a floral peduncle, which is naked, that is to say, without leaves, and which springs directly from the collar of the root, and terminates in one or more flowers, as in the hyacinth.

The radical peduncle (pedunculus radicalis) differs from the scape in this, that instead of growing from the centre of an assemblage of radical leaves, it issues from the axilla of one of those leaves, as in the plantains (plantago media, plantago lanceolata,) &c.

Five different species of stems are distinguished, and this distinction is founded on their organization and on their peculiar modes of development. These species are, 1°. The trunk. 2°. The stipe. 3°. The culm. 4°. The stock root. 5°. The stem, properly so called.

1°. The term trunk (truncus) is applied to the

stems of our forest trees, of the oak, of the fir, of the ash, &c. It possesses the characters of being conical and elongated, that is to say, of being thickest at the base. In the lower part it is naked; at the top, it is terminated by divisions which are successively smaller, and which have received the names of primary and secondary branches, of ramules and of ramuscles. These usually bear the leaves and the organs of reproduction. The trunk is peculiar to dicotyledonous trees. Composed internally of concentric layers placed within each other, it grows in length and thickness by the addition of new layers to its circumference.

2°. The stipe (frons, stipes) is a kind of stem observed only in monocotyledonous plants, such as the palms, dracæna, yucca, and in certain dicotyledonous plants; to wit, cycas and zamia. It consists of a species of cylindrical column,* that is to say, as large at the top as at the root, (which is not the case in the trunk,) sometimes even thicker in the middle than at either extremity, rarely branched, crowned at the top by a cluster of leaves mixed with flowers. Its bark, when it has one, is usually difficult to be distinguished from the

* It is often known by the name of columnar trunk or stem

rest of the stem. Its growth in height is effected by the development of the bud which terminates it at the top. It grows in thickness by the multiplication of the filaments of its circumference.

We shall soon see, in treating of the anatomical structure of stems, that the stipe differs not less from the trunk in its internal organization, than by the physical characters which we have now adverted to.

3°. The culm (culmus) is peculiar to the grasses, that is, to the wheat, the barley, the oats, &c.; to the cyperaceæ, to the junci, &c. It is a simple stem, rarely branched, generally fistulous,* (that is to say hollow within,) and divided at different distances by a species of knots or partitions, from which arise alternate sheathing leaves.

4°. The stock root or rhizoma.† This name is given to the subterraneous horizontal stems of perennial plants, either wholly or partially concealed under the earth, shooting up new stems from their anterior extremity, in proportion as the posterior part perishes. This subterraneous stem has generally received the improper name of progressive root, of truncated root. Ex: iris,

* Sometimes, however, it is full within, as in the sugar cane, the Indian corn.

† Derived from ῥιζα a root, and σωμα a body.

devil's bit scabious, Solomon's seal.* Besides its direction, which is nearly horizontal under the earth, one of the principal characters of the stock root, a character by which it is readily distinguished from the root, is always to exhibit on some part of its surface traces of the leaves of former years, or scales which occupy their places, and to grow by its base or the extremity next to the leaves, the contrary of which happens in the true root. (See Pl. 2. fig. 7.)

5°. Lastly, the common and general name of stem is given to all those, which differing from the four preceding species, cannot be referred to any of them. The number of vegetables possessed of a stem, properly so called, is much more considerable than that of those which have a stipe, a culm, or a trunk.

We shall now proceed to examine the stem in general, with respect to the various modifications which it may exhibit.

A. With respect to consistence, the stem may be:

1°. Herbaceous (herbaceus,) that which is ten-

* The number of plants possessed of a subterraneous stem is much greater than is usually imagined. A great many plants, which are said to have no stem, and several perennial plants, are provided with a stock root, which is more or less developed. The tuberous root is a true stock root.

der, green, and which perishes annually. Such are those of annual, biennial, and perennial plants, the chick weed, borage, comfrey, &c. All these plants take the general name of herbs, (herbæ.)

2°. Subligneous (suffruticosus,) when the base is hard and persistent, standing above ground for several years, while the branches and their extremities perish and are renewed annually. Such are rue (ruta graveolens,) garden thyme (thymus vulgaris,) sage (salvia officinalis). Vegetables which have such a stem as this, bear the name of undershrubs (suffrutices.) They are destitute of scaly buds.

3°. Ligneous (lignosus,) when the stem is persistent, and when its hardness is similar to that which is known to belong to wood in general. Vegetables with a woody stem are divided into:

Shrubs (frutices,) when they are branching from their base and bear no buds; for example, the heaths.

Arbuscles (arbusculæ,) if they are ramified at their base and have buds; as the hazel, the lilach.

Lastly, they retain the name of trees properly so called, when they have a trunk which is naked in its lower part, and branching only towards the upper part; the oak, the elm, the pine, &c.

This division is perfectly arbitrary, and does

not exist in nature. In fact, a tree of the same species may exhibit these three modifications of size, according to the exposure in which it is placed, or from the influence of cultivation. Thus the dwarf elm and the box, which by frequent prunings, serve as borders to parterres in our gardens, are absolutely of the same species with the common box and elm, whose stems, particularly that of the latter, usually attain to a very considerable height when those vegetables are left to themselves.

4°. Solid or full (solidus,) when it has no cavity within it. For example, the trunks of most trees. This epithet is always used in opposition to the following:

5. Fistulous (fistulosus,) having an inner cavity either continuous or separated by horizontal partitions: the arundo donax, angelica, œnanthe fistulosa, the bamboo cane, cecropia peltata, a large tree of South America, whose trunk is always hollow, and therefore called cannon wood by the natives.

6°. Medullary (medullosus,) full of pith: the elder, the fig, &c.

7°. Spongy (spongiosus,) formed internally of an elastic, spongy, compressible tissue, retaining moisture like sponges. Ex: typha latifolia, scirpus lacustris, &c.

8°. Soft (mollis, flaccidus,) when it cannot sup-

port itself, and falls on the ground; for example, the scarlet pimpernel (anagallis arvensis.)

9°. Firm or rigid (rigidus,) when it ascends directly and supports itself erect: ex, the bistort (polygonum bistorta.)

10°. Flexible (flexibilis,) when it can be easily bent or knotted without breaking: the osier.

11°. Fragile (fragilis,) when it is rigid and breaks easily: that of the herb robert (geranium robertianum.)

12°. Fleshy (succulentus,) that which contains a great quantity of juice or of watery fluid; for example, borage, purslane. Fleshy stems may be milky, that is to say, may contain a whitish, lactiform, or a yellowish juice, such as the spurge, common celandine, the poppy, &c.

B. With respect to form, the stem may exhibit a great many modifications. Thus it is called:

1°. Cylindrical (cylindricus) when its general form approaches to that of a cylinder, that is, when its transverse section forms a circle, whose different diameters are nearly equal. This form occurs in the trunks of most of our forest trees, and in certain herbaceous plants, such as the thorn apple (datura stramonium,) flax, &c.

2°. Wand like (virgatus,) or resembling a rod, that which is slender, long, straight, and considerably elongated, as it diminishes from the base

to the top. Such is that of marsh mallow (althæa officinalis,) of Dyer's weed, (reseda luteola,) of Lythrum salicaria.

3°. Compressed (compressus,) when it is slightly flattened on the two opposite surfaces, (poa compressa.)

4°. Two-edged (anceps,) when the surfaces are compressed to such a degree as to form two cutting edges like that of a sword.

5°. Angular (angulatus,) when it is marked with angles, or longitudinal projecting lines, whose number is determinate.

Accordingly as the angles are obtuse or acute, it is called obtusangular, acutangular.

According to the number of angles, and therefore of distinct surfaces which it exhibits, it is called triangular, three-edged, or three-sided, (triangularis, trigonus, triqueter,) when it has three angles. Such are many species of carex, scirpus sylvaticus, &c.

Quadrangular, four-edged, (quadrangularis, tetragonus,) when it has four angles and four surfaces. If the angles and surfaces are equal, it is square; such are most of the labiate plants; for example, mint, sage, horehound, &c.

Pentagonal (pentagonus,) when it presents five surfaces.

Hexagonal (hexagonus) when it exhibits six.

6°. The stem is said to be angulose (angu-

losus) when the number of angles is very considerable, or when it is not intended to determine it with precision.

7°. Knotty (nodosus,) presenting knots or swellings at different distances. The grasses, geranium robertianum.

8°. Jointed (articulatus,) composed of joints placed above each other, and connected by their extremities: the misseltoe, many of the caryophyllaceous family, &c.

9°. Geniculate (geniculatus,) when the joints are bent so as to form an angle : ex, alsine media, geranium sanguineum.

10°. Sarmentaceous (sarmentosus,) a fruticose stem too feeble to support itself, and ascending along the neighbouring bodies, either by means of peculiar appendages called tendrils, or by simply twining around them : for example, the vine, the woodbine.

11°. Climbing (scandens, radicans,) that which raises itself on surrounding objects, and clings to them by the means of roots, as the ivy (hedera helix,) the bignonia radicans, &c.

12°. Twining (vobubilis,) the stem which winds spirally round neighbouring bodies. It is well worthy of remark, that the same plants do not begin their spiral course indifferently to the right or to the left. They are constantly directed to the same side in the same species. Thus, when

the spire ascends from left to right, the stem is said to be dextrorsum volubilis, as in the hop, the woodbine. On the contrary, it is said to be sinistrorsum volubilis, when it winds from right to left; for example, in the kidney bean, dolichos, bind weed.

13°. Slender (gracilis,) when it is very long compared with its thickness, for example, stellaria holostea, orchis conopsea, &c.

14°. Filiform (filiformis,) when it is very slender and stretched along the ground, as in the cranberry, (vaccinium oxycoccos.)

C. According to its composition, the stem is distinguished into:

1°. The simple (simplex,) when it has no marked ramifications; example, the great mullein (verbascum thapsus,) the purple foxglove (digitalis purpurea.)

2°. Branched (ramosus,) divided into primary or secondary branches. The stem may be branching from its base (basi ramosus,) as the common furze (ulex europæus), or only towards its summit (apice ramosus.)

3°. Dichotomous (dichotomus,) when it is divided by successive bifurcations; such is that of the corn sallad (fedia olitoria) of the thorn apple (datura stramonium.)

4°. Trichotomous (trichotomus,) divided by

trifurcations, as in the marvel of Peru (nyctago hortensis.)

As to the disposition of branches with respect to the stem, since their different modifications are perfectly analogous to those which we shall notice in the leaves, we think it useless to speak of them here, what we shall soon say of the position of leaves upon the stem, being equally applicable to that of the primary and secondary branches.

D. According to its direction, the stem is said to be :

1°. Vertical or erect (verticalis, erectus,) when its direction is vertical with respect to the horizon ; for example, that of the rampion (campanula rapunculus,) of toad flax (antirrhinum linaria.)

2°. Prostrate (prostratus, procumbens,* humifusus,)† when it never rises, but lies along the ground without striking root ; for example, dwarf mallow (malva rotundifolia) wild thyme (thymus serpyllum, &c.

3°. Creeping (repens,) when it lies on the earth, and takes root in it by every point of its extent : ex moneywort (lysimachia nummularia.)

4°. Stoloniferous (reptans, stoloniferus,) send-

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* Prostratus, lying prostrate on one side.

† Humifusus, spread out in every direction.

ing out from the principal stem, small, slender, lateral ones, called stolones or runners, capable of striking root and of re-producing new plants; for example, the strawberry (fragaria vesca.)

5°. Olique (obliquus,) rising obliquely to the horizon.

6°. Ascending (ascendens,) forming at its base a curve, whose convexity looks to the earth, and being erect in its upper part; for example, common clover (trifolium pratense,) spiked speedwell (veronica spicata.)

7°. Reclined (reclinatus,) erect, but suddenly bent downwards at the top, as in some species of gooseberry.

8°. Tortuous (tortuosus,) forming several curves in different directions, for example, bunias cakile.

9°. Spiral (spiralis,) forming curves of a spiral figure; for example, most species of costus.

D. According to its vestiture and its appendages, the stem is:

1°. Leaf-bearing (foliatus,) such is in general the greatest number of stems.

In another sense, a stem is said to be leafy (caulis foliosus,) when it is covered with a very considerable number of leaves.

2°. Leafless (aphyllus,) destitute of leaves: the dodder (cuscuta.)

3°. Scaly (squamosus,) bearing leaves which resemble scales, such as the broom rape.

4°. Winged (alatus,) furnished longitudinally with membranous or foliaceous appendages, generally proceeding from the leaves, as in common comfrey (symphytum officinale,) in the great mullein (verbascum thapsus.)

F. Considering the surface of the stem we find it:

1°. Smooth (Lævis,) when the surface has no kind of asperity or of eminence, (tamus communis.)

2°. Glabrous (glaber,) destitute of hairs; greater periwinkle, (vinca major.)

3°. Lævigated (Lævigatus,) glabrous and smooth.

4°. Powdery (pulverulentus,) covered with a kind of powder produced by the vegetable (primula farinosa.)

5°. Glaucous (glaucus,) when this powder forms a very thin layer, which is easily removed, and which is of a sea green colour; example, cucubalus behen, chlora perfoliata, &c.

6°. Dotted (punctatus,) having more or less prominent and numerous points, as the rue (ruta graveolens.) These points are usually small vesicular glands, full of essential oil.

7°. Spotted (maculatus,) marked with spots of various colours; for example, the cuckoo pint (arum maculatum,) orchis maculata, &c.

8° Rough (scaber, asper,) whose surface pre-

sents to the finger a roughness, which is imperceptible to the sight, and which appears to depend upon very small hairs, that are coarse and very short, as for instance, corn gromwell (lithospermum arvense.)

9°. Warty (verrucosus,) presenting small scaly excresences called warts, such as the spindle tree (euonymus verrucosus.)

10°. Corky (suberosus,) that whose bark is of the nature of cork, as the cork tree properly so called (quercus suber.)

11°. Cleft (rimosus,) having deep, unequal clefts, as the elm, the oak, and a great many other trees.

12°. Striated (striatus,) having small longitudinal projecting lines, called striæ, as the sorrel (rumex acetosa.)

13°. Furrowed (sulcatus,) presenting longitudinal furrows, which are more or less deep: cicuta, parsnip.

G. The pubescence of the stem has caused it to receive the following denominations:

1°. Pubescent (pubens,) furnished with soft hairs, which are very fine and close, but distinct; for example, the purple foxglove (digitalis purpurea,) white saxifrage (saxifraga granulata.)

2°. Hairy (pilosus,) covered with long hairs, which are soft and few in number: example, agrimoney (agrimonia eupatoria,) crow foot (ranunculus acris.)

3°. Villous (villosus,) when the hairs are soft, long, and very close.

4°. Woolly (lanatus,) covered with long hairs, frizzled and coarse like wool; for example, ballota lanata.

5°. Cottony, when the hairs are white, long, and soft to the touch like cotton ; ex stachys germanica, hieracium eriophorum.

6°. Silky (sericeus,) when the hairs are like silk, long, soft to the touch, shining, and not entangled (protea argentea.)

7°. Shaggy (tomentosus,) when the hairs are short, entangled, and seem to be woven like cloth ; example, the great mullein.

8°. Ciliated (ciliatus,) when the hairs are disposed in rows or lines which are more or less regular; example, veronica chamædrys, which has two opposite rows; common chick weed, which has only one.

9°. Hispid (hispidus,) furnished with long hairs, which are stiff and tubercular at the base, galeopsis tetrahit, sinapis arvensis.

H. The armature with which the stem is sometimes furnished has caused it to be named ;

1°. Spinous (spinosus,) armed with spines, as gleditschia ferox, genista anglicana, &c.

2°. Prickly (aculeatus,) having prickles, as the roses.

3°. Unarmed is used in opposition to the two

former terms; that is to say, without spines or prickles.

The Anatomical Structure of Stems.

In speaking on a former occasion of the distinction between trunks and stipes, we remarked, that these two species of stems, one of which belongs to the great class of dicotyledons, and the other to the monocotyledons, differ as much in their internal structure, and in the arrangement of the elementary parts which compose them, as in their external characters. We shall soon see that science is indebted for this important discovery to M. Des Fontaines. This learned botanist is the first who has accurately made known the internal organization and anatomical structure of the stems of vegetables, and particularly of the monocotyledons. Accordingly, the opinions which we are about to express upon this subject are, in a great measure, due to this celebrated naturalist. But it will be convenient to examine separately the organization of the stems of the dicotyledons, and afterwards that of the monocotyledons.

FIRST SECTION.

OF THE ORGANIZATION OF THE STEMS OF DICOTYLEDONS.

The trunk of dicotyledonous trees is formed of concentric layers placed within each other, so that, it may be compared to a series of tubes set the one within the other, and increasing in magnitude from the centre to the circumference. A transverse section of it presents for our consideration the following objects: 1°. In the centre, the medullary canal, formed of the medullary tube, which constitutes the parietes of the canal, and of the pith which occupies its cavity. 2°. At the circumference is seen the bark, which is composed of the epidermis, or of that external pellicle which covers all parts of the vegetable, of the herbaceous integument, of the cortical layers, and of the liber. 3°. Lastly, between the medullary tube and the bark are found the woody layers, composed externally of alburnum or false wood; internally of wood properly so called. We shall now consider these different parts in succession, proceeding from the circumference to the centre.

§ 1. *Of the Epidermis.*

The epidermis (epidermis, cuticula) is a thin, nearly diaphanous layer, composed of an uniform tissue, which appears to consist of cells of an extremely variable form, and which presents a great number of small openings or pores, regarded by some authors as so many open mouths of vessels. It covers all parts of the vegetable, but it is particularly distinct on young stems, from which with a little care, it can be easily separated. As it possesses only a certain degree of extensibility, beyond which it cannot be stretched, it tears and cracks when the trunk has acquired a certain size, as is observed in the oak, in the elm; at other times it falls off in patches or plates, as in the birch tree, the plane tree. When removed from a young stem, it is very easily regenerated. It is that part of the vegetable which resists decomposition longest; putrefaction produces no sensible effect upon it. The colour which it exhibits is not inherent in its nature, but depends upon the peculiar colour of the tissue to which it is applied. The nature and origin of the epidermis are two points of vegetable anatomy which are rather obscure. Some authors say, with Malpighi, that the epidermis is not a membrane distinct from the rest of the vegetable tissue. They regard it as com-

posed of the outer wall of the subjacent cells, that belong to the herbaceous integument, which wall has been indurated by the continued action of air and light. Others on the contrary, and perhaps Grew is to be considered as the author of this opinion, regard it as a perfectly distinct membrane, merely applied to the subjacent cellular tissue. We are indebted to Professor Amici for microscopical observations of the highest importance, which throw great light upon this question, and seem to confirm the latter of these two opinions. According to this pholosopher, the epidermis is a membrane perfectly distinct from the cellular tissue over which it lies. Examined with the microscope, it is found to be composed of a simple layer of cells, whose form is extremely variable according to the different species. It was this cellular structure that led into error those authors who believed that the epidermis was composed of the outer wall of the cellular tissue. But if this were so, the cells of the epidermis ought always to have the same form with those of the subjacent tissue, which is not the fact. Thus, in the pink, the cells of the epidermis have a quadrilateral form, while the layer placed immediately under it, is composed of a multitude of small tubes perpendicular to the epidermis. The case is the same in a great number of other vegetables; whence it is fair to conclude, that the epidermis is

a cellular membrane, wholly distinct from the subjacent tissue, over which it is simply applied. The epidermis, as has been already observed, presents a great number of openings, called cortical pores, cortical glands, epidermoidal glands, and lastly stomata. Many authors have denied their existence; but the microscopical observations of Professor Amici leave no doubt upon the subject. He has seen them in a great number of vegetables, and has given a description of them, with very accurate drawings. They are a species of small bags placed in the thickness of the epidermis, opening externally by a slit or an elongated oval aperture, which is bordered by a kind of prominence, composed of the peculiar cells of the epidermis. This prominence, which is very rarely wanting, performs the office of a kind of sphincter, which contracts or dilates the opening according to circumstances. Thus, moisture or water closes the pores, while dryness and the action of the sun's rays keep them open and their edges asunder. These motions of dilatation and contraction are executed not only in the living plants, but equally so in fragments of the epidermis detached from the vegetable. At their bottom, these pores or little bags always correspond with empty spaces full of air, which result from the arrangement of the cells or tubes with respect to each other. These intercellular spaces

almost always communicate with each other, and thus favour the diffusion of the elastic fluids contained within vegetables. Some parts, however, appear to be destitute of stomata, such as roots, petioles which are not foliaceous, petals in general, the epidermis of old stems, that of fleshy fruits, of seeds, &c. Certain leaves present them only on one of their surfaces, others, on the contrary, on both. What is the use of these cortical pores? Are they, says M. Amici, destined for the absorption of moisture? No; we have already seen that they correspond with empty spaces without any sap; that water makes them close; and that light and dryness keep them open. Besides, they are wanting in all roots, and in plants which live constantly in water. They do not, therefore, serve for the absorption of water; neither do they serve for evaporation. If we leave a plant to dry which is detached from its root, although, in a short time, the pores become closed, evaporation goes on nevertheless, as long as there remain any fluids within it. It has been also observed, that the corolla and the fruit, which have no cortical pores, produce notwithstanding a copious evaporation. They cannot, as Link had supposed, be placed among the excretory organs, because they always correspond with empty spaces. The true office of cortical pores consists in affording a passage to air; but it cannot be easily determined with certainty, if they serve for inspiration, rather than

for expiration, or equally for both. When it is considered, that, by night, when the great pores of the epidermis are closed, the leaves absorb the carbonic acid gas dissolved in the dew, which unquestionably penetrates into the cells by passing through their membranes, and also that these leaves decompose carbonic acid, when the pores are open, that is to say by day, there is ground for admitting that they are solely destined for the exhalation of oxygen. This opinion becomes more probable when it is added, that the corolla, which according to the observations of De Candolle, has no pores, is also destitute of the power of disengaging oxygen. The surface of the epidermis sometimes exhibits organs, which appear under the form of small spots, elongated in the longitudinal direction upon young branches, and in the transverse direction upon the old, which Guettard first designated by the name of lenticular glands, and which De Candolle has more recently called lenticelles. No trace of them has been as yet discovered either in monocotyledonous plants, or in the acotyledonous. They are also wanting in dicotyledonous herbs. They are very distinct on the epidermis of the birch, and particularly of the spindle tree (euonymus verrucosus) on which they are very prominent and very numerous. From these lenticelles issue the roots, which are developed on the stems of certain trees,

as of some figs, for instance, or those which are formed when a branch is stuck in the ground, as in propagating by layers. They may, in a manner, be considered as the root buds.

The surface of the cuticle also produces the different species of hairs, which are observed on a great number of vegetables.

§ 2. *Of the Herbaceous Integument.*

UNDER the epidermis is observed a layer of cellular tissue which connects it with the cortical layers, and to which M. Mirbel gives the name of herbaceous integument. In young stems its colour is generally green. It covers the trunk, the branches and their divisions, and fills up the spaces between the ramifications of the nerves of leaves. M. Du Trochet calls it the outer medulla in opposition to the pith, which he calls the inner medulla. Its colour is not derived from the cellular tissue which composes it, but depends on small grains of globuline placed in the parietes of the cells, and which M. Du Trochet considers as nervous substance. The herbaceous integument or outer pith, often contains the proper juices of vegetables, which exist in peculiar canals or reservoirs. It is easily repaired on the stems of woody vegetables, but this never happens on those of annual plants. It appears to have an organi-

zation and uses similar to those of the pith contained in the medullary tube. The herbaceous integument, having acquired considerable thickness and peculiar physical qualities, constitutes the part known by the name of cork in the quercus suber, and in some other vegetables. The herbaceous integument is the seat of one of the most remarkable chemical phenomena which vegetable life exhibits. Within its substance, by a cause whose nature is difficult to comprehend, is effected the decomposition of the carbonic acid absorbed by the plant from the surrounding air. The carbon remains within the vegetable, the oxygen, being liberated, is expelled from it. It is necessary, however, to observe, that this decomposition happens only when the plant is exposed to the rays of the sun; for the carbonic acid is given out unchanged when the vegetable is not under the influence of that body. This organ is partly renewed every year. It performs a very important office in the process of vegetation. In fact, at the return of spring, it invites the sap to ascend towards the buds, and thus becomes one of the most powerful causes of their development.

It is very easy to discover the herbaceous integument on the young branches of trees; for it is the part which is observed on removing the epidermis.

§ 3. *Of the Cortical Layers.*

The cortical layers do not always exist, or, at least, they are sometimes so slightly developed, so hard to distinguish from the liber, that it is very difficult to recognise them. Placed under the herbaceous integument, they are applied to the outer layers of the liber, from which they can hardly be distinguished. No vegetable exhibits them more distinct and more remarkable, on account of the singular disposition of the tissue which composes them, than the lace wood (lagetto.) Here they form several layers placed over each other, which, when extended, perfectly resemble, a woven cloth, or rather a very regular lace work. But, in the greatest number of plants, it is difficult to distinguish this part from the liber.

§ 4. *Of the Liber.*

The liber is found between the cortical layers which are on its outside, and the corpus ligneum which lies within it.

This organ consists of a vascular net work, whose elongated meshes are filled up with cellular tissue. It rarely happens that, as is indicated by the name, it can be separated into distinct layers, which have been compared to those of a book.

But by maceration it is almost always possible to produce this effect. The different layers which form the liber, and which have been produced in succession, are separated by a thin layer of cellular tissue. When the liber is macerated this cellular tissue is destroyed, and permits the separation of the layers which compose the liber.

Like all the other parts of the bark, the liber is capable of being repaired, when it has been removed. But for this purpose, the air ought to be excluded from the part from which it has been separated. We are indebted to Du Hamel for this important discovery. This able naturalist, to whom we owe so many useful results of experiments in vegetable physiology, removed a portion of the bark from a vigorous tree in full vegetation. He guarded the wound against the contact of air, and soon saw exude from the corpus ligneum, and from the edges of the bark, a viscid fluid, which, spreading over the wound, acquired a greater consistence, became green and cellular, and re-produced the part of the liber which had been removed.

To this viscid substance, which is effused from the denuded parts to regenerate the liber, Grew, and after him Du Hamel, have given the name of cambium. Several authors think, with reason, that cambium is nothing but the descending and elaborated sap. I am the more disposed to admit

this opinion, as that viscid substance performs, in the vegetable economy, precisely the same functions that are generally attributed to the descending sap, and as it is conveyed by the same parts.

Whatever may be the origin of the cambium, it performs a very important part in the growth of stems. In fact, every hypothesis published for the purpose of explaining this phenomenon, assumes its existence as quite indispensable, as we shall shortly shew, in treating of the growth of dicotyledonous stems.

A great number of facts prove the indispensable necessity of liber for the process of vegetation. A graft will not take, unless its liber be in contact with that of the tree on which it is inserted. A cutting will not strike root, if its lower part be stripped of its liber. If a circular band of liber be removed from the trunk of a tree, so as to leave the corpus ligneum naked, not only will the whole of its upper part not grow on the following year, but the entire tree will ultimately perish. Each year the liber hardens; new layers are formed on its inner surface by means of the cambium.

§ 5. *Of the Alburnum, or False Wood.*

The external woody layers, in contact with the liber, constitute the alburnum. This part is

not an organ distinct from the wood, properly so called, whose layers are placed within it. It is real wood, but still young, and not possessed of all that hardness and tenacity which distinguish it at a later period. Accordingly, alburnum has precisely the same structure as wood, with this difference, that its tissue is composed of fibres, which are weaker, more distant, and generally of a lighter colour.

The difference in colour between wood and alburnum is very remarkable in those trees whose wood is very hard and compact, and particularly in those whose colour is of a deeper shade. Thus in ebony or logwood, the wood, properly so called, is black, or of a deep red, while the layers of alburnum are of a clear greyish colour; but in trees whose wood is white and coarse grained, the difference between the woody layers and the alburnum is scarcely perceptible.

In speaking of the growth of stems in thickness, we shall consider the very different opinions of authors respecting the origin of alburnum.

§ 6. *Of the Wood, properly so called.*

The wood derives its origin from the innermost layers of the alburnum, which successively acquire a greater degree of hardness, and are ultimately converted into true wood. The latter,

therefore, consists of all the circular layers between the alburnum and the medullary tube. At a certain period of the life of vegetables, there are annually formed a layer of wood and a layer of alburnum; that is to say, the innermost layer of alburnum is changed into wood, at the same time that a new layer of alburnum is produced externally, so that every year a new concentric zone is added to those that existed before. The wood is generally the hardest part of the trunk; but its hardness is not the same in all the layers that compose it.

In dicotyledonous trees, the innermost layers, which are also the oldest, are more solid and compact than the external layers, which, in that respect, approach to the alburnum. In general, the transition from wood to alburnum is almost insensible, because they are usually of the same colour. But sometimes the difference is very striking, as we have remarked in the instance of ebony and of logwood.

A difference not less remarkable between the alburnum and the wood is, that the former is wholly destitute of vessels, while the wood, on the contrary, abounds with them. The vessels of the wood are either false spirals or porous vessels; but it never contains the true spirals. It is by means of these tubes, sometimes scattered without any order in the substance of the wood, some-

times collected in bundles, that the sap is conveyed into the body of the stem. But a period arrives when, through age, the parietes of these vessels are thickened, their cavity is diminished, and ultimately obliterated, and the course of the fluids in the wood is for ever arrested.

Du Hamel has clearly demonstrated the conversion of alburnum into wood. He passed a silver wire into the layers of the alburnum, drew out its two extremities, and knotted them. Having cut the branch a few years after, and examined the wires which he had passed into the alburnum, he found them in the wood, which proves that the former was changed into the latter.

§ 7. *Of the Medullary Tube.*

THE medullary tube, as we have already mentioned, occupies the middle of the stem. It lines the innermost layer of the wood, and its office is to contain the pith. Its parietes are composed of very long vessels, which are parallel and disposed in a longitudinal direction. These vessels are spirals, false spirals, and porous vessels. It is in the medullary tube alone, that we have heretofore been able to discover the spiral vessels. The form of the medullary tube is not the same in all vegetables; very often it is round, sometimes however the area of the medullary tube is elliptical,

compressed of three, four, five, or a greater number of angles. This form, as has been proved by Palisot de Beauvois, seems to be determined by the position of the leaves on the branches. Thus, when the leaves are opposite, the section of the medullary canal is elliptical, as for instance, in the ash; if the leaves are whorled by threes, the medullary canal shall be triangular, as may be observed in the rose laurel, and so of others. Yet this law is far from being general, and there are a great many exceptions to it. Thus, for instance, hortensia, whose leaves are opposite, has a medullary canal which is a regular hexagon.

The medullary tube being once formed, its figure and dimensions remain the same through the entire life of the vegetable. It is therefore an error to say, that the medullary canal contracts gradually, and is at last obliterated. M. Du Petit Thouard, was the first to prove that the medullary canal is subject to no variation in this respect.

§ 8. *Of the Pith.*

The pith or inner medulla is that spongy, loose, diaphanous and light substance, composed almost exclusively of cellular tissue in its simple state, which fills the medullary tube. Some vessels seem to pass through it longitudinally. The cells of the cellular tissue which form the

pith, have, in general, a considerable degree of regularity. Like those of the cellular tissue in other parts, they all communicate with each other. Sometimes, and particularly in young branches and herbaceous plants, the cellular tissue of the pith is impregnated with fluids, and full of green granulations. This may be seen on breaking a young branch of elder of one year old. The pith appears to be a fleshy, green, and very humid substance. But, in the course of vegetation, all these substances, which are in some respect foreign to the true nature of the pith, disappear, and nothing remains in the medullary tube but diaphanous tissue.

In some vegetables, in proportion as the stem grows, the medullary canal is partially and sometimes wholly emptied; the entire pith at last disappears and the stem becomes hollow or fistulous. This is what may be observed, for instance, in the stems of a great many of the umbelliferæ. The pith communicates with the herbaceous cellular layer of the bark, by means of peculiar prolongations, which cross the corpus ligneum. These prolongations, which are seen on a transverse section of the trunk, diverging from the centre to the circumference, have received the name of medullary insertions or prolongations. They serve to establish a direct communication between the pith and the external cellular tissue of the stem.

The medullary rays exist also in the greater part of the thickness of the bark, inasmuch as they serve to establish a communication between the inner medulla and the outer; but those of the bark have no direct communication with those of the woody layers.

Professor Amici has ascertained that they are formed of small porous tubes, placed in a transverse direction, which never contain any thing but air, and which establish a communication between the inner parts of the plant and the outer.

If we now try to ascertain the uses of the pith, we shall find that the opinions on this subject have undergone a great many changes. Thus, according to the celebrated Hales, it is the essential cause of vegetation. Being elastic and dilatable, it acts, as it were, like a spring on the other parts, and thus favours their development. Others, on the contrary, consider it as a perfectly inert body. M. Du Trochet has lately revived the opinion of Hales, by making the pith perform a very important office in the growth of vegetables. We shall soon return to the consideration of this opinion. Such are the different organs found in analysing the stem of dicotyledonous vegetables; yet all these parts are far from being constantly united and visible in the same plant. Sometimes they are so confounded together, that it is almost impossible to distinguish and to sepa-

rate them. But when the most complicated structure of a part is well understood, it is easy, in certain cases, to imagine those organs which are accidentally wanting. It now remains to study, comparatively, the stem of the monocotyledons, in order to explain hereafter the peculiar mode of developement and growth belonging to each of the two great divisions of the vegetable kingdom.

SECTION II.

OF THE ORGANIZATION OF THE STEM OF MONOCOTYLEDONS.

M. Desfontaines was the first who established the great division of phanerogamic vegetables into monocotyledons and dicotyledons, by the anatomical structure of their stem, which is so different in those two classes. He was the first in fact, who, in an excellent memoir inserted in the first volume of the Memoirs of the Institute, made known the true organization of monocotyledonous stems, and the characters that distinguish it from that of the dicotyledons.

In general, the stem of the monocotyledons is more lofty and simple than that of the dicotyledonous tree. It is very rarely divided into branches like that which we have lately studied.

The stipe of a monocotyledonous tree, of a palm for instance, when cut in a transverse direction, does not exhibit, like the trunk of an oak, of an elm, or of any other of our forest trees, a regular and symetrical aspect; there are no circular zones of wood, of alburnum, of liber, and of bark always arranged in the same order; no medullary canal always occupying the central part of the stem. Here, all the parts seem to be united, or rather confounded with each other. The pith occupies the entire thickness of the stem; the wood, disposed in longitudinal bundles, is lost in a manner, and as it were dispersed without order in the midst of the medullary substance. The bark does not always exist, and when it is not wanting, it is so indistinct from the other parts of the stem, that they might be considered as not covered by it.

In dicotyledonous trees, the hardest part is that which is next to the centre of the stem, as being formed of the oldest layers of wood. The contrary takes places in monocotyledonous trees, in which the part nearest to the circumference is found to have the greatest density. In the former, in fact, the oldest layers are in the centre; on the contrary, they occupy the circumference in the latter. This will be made perfectly clear by explaining the mode of growth of the stems of monocotyledonous trees. The woody bundles of

the stem, which often unite laterally, so as to form a more or less regular net work, are accompanied, as in the dicotyledons, with porous vessels, spirals, and false spirals, destined to convey the sap and the other nutritious fluids into all parts of the stem.

Thus then, the monocotyledons are distinguished from the dicotyledons, not only by the structure of their embryo, but also by that of their stem. In fact their stipe, which is generally simple and cylindrical, does not exhibit, like the trunks of oaks and of elms, layers of wood which are placed within each other, and regularly disposed around a central canal containing pith. But the pith, in a manner, forms the whole thickness of the trunk, and the woody fibres, instead of being united and in contact with each other, are distant, isolated, and their fibres are scattered in the midst of the spongy substance of the pith. In treating, in the fourth section, of the growth and developement of stems, we hope to prove that the organ so called in the woody monocotyledons, and particularly in the palms, dracæna, yucca, &c. is not a true stem, but an organ wholly distinct from it.

SECTION III.

OF THE ORGANIZATION OF THE ROOT.

Now that the internal structure of the different species of stems is known to us, we shall find it easier to take a comparative view of that which is presented by the roots. All roots are generally organized like the stems. Thus, in transverse sections of the roots of dicotyledonous trees, we find concentric zones of wood arranged circularly, and placed within each other. It is said that the truly distinctive character between stem and root is, that the latter is destitute of medullary canal, and therefore of pith; while, on the contrary, it is admitted, that this organ exists invariably in dicotyledonous trees. From this it follows necessarily, that medullary insertions also are wanting in the root.

Yet this difference appears to us of little importance, and even in direct opposition to facts. In truth, we have found, in a great number of vegetables, that the medullary canal of the stem is continued without any interruption into the body of the root. If, for example, the trunk and root of a horse chesnut of two years old be slit longitudinally, the medullary canal of the stem will be seen to extend to the lowest part of

the root. It is the same, if we examine a young plant of sycamore or maple. But, very often, this canal, which was very manifest in the plant shortly after its germination, at last diminishes, and even gradually disappears in the progress of vegetation, so that it is no longer found in those adult plants which contained it when young. From this it follows, that the absence of medullary canal in the root cannot be reckoned a distinctive anatomical character between it and the stem, because it almost invariably exists in the germinating radicle of the seed, and often in the root of a great number of vegetables, long after this first period of their life. Yet the vertical roots never have it in their ramifications, not even in those which are thickest. Until very lately, the want of spiral vessels in the root, was set down as a distinctive character between the anatomical structure of that organ and of the stem; but two of the naturalists, who, in Germany, have been most successfully engaged in cultivating vegetable anatomy, Messrs. Link and Treviranus, have discovered those vessels in the roots of several plants. Still more recently, M. Amici has unfolded spirals in the roots of many plants, and among others, of the agapanthus umbellatus, and of the crinum erubescens. The difference which we have seen to exist between the organization of the trunk of dicotyledons and of the stipe of monocotyledons, is also observed in their roots. In fact, in mono-

cotyledonous plants, there is never observed a vertical root continuous with the stem. This is an effect of the seed's mode of developement during germination; for the central and principal radicle is always destroyed soon after germination, as will be seen more fully in treating of that process.

There is also another remarkable difference between roots and stems. The latter generally grow in height by every point of their extent, while the roots are lengthened only by their extremity. This was proved by the experiments of Du Hamel. Let small marks be placed on the stem of a young tree during its growth, an inch, for instance, asunder, and it will be seen, when the growth is completed, that their distance is considerably greater. Let a similar experiment be tried on roots, and it will be manifest that, as these spaces remain the same, while the root is lengthened, it must have grown only by its extremity.

SECTION IV.

GENERAL CONSIDERATIONS RESPECTING THE GROWTH OF VEGETABLES, AND PARTICULARLY RESPECTING THE DEVELOPEMENT OF THE STEM.

All bodies in nature have a tendency to grow. This law is common to inorganic as well

as to organized beings. But growth exhibits very striking differences, accordingly as it is studied in these two primary groups of natural bodies. In minerals it has no settled limits. These bodies grow continually, until some accidental cause puts an end to their developement. As the duration of animal and vegetable life is generally limited, their growth has always a reference to the duration of their existence. In minerals, new molecules are added externally to those which already existed, and which formed the primitive nucleus; so that the surface of these bodies is renewed every instant, in proportion as their volume increases. Hence the name of juxta position given to the mode of growth peculiar to inanimate bodies. If, on the other hand, you study growth in beings possessed of organization, you shall see that it takes place from within outwards; that, either parts originally existing are elongated, or that new organs are formed within the old, and developed in all directions so as to increase the mass and volume of the body. Accordingly, that mode of growth which belongs to animals and vegetables, has received the name of intussusception. Growth exhibits differences which are equally striking, when animals and vegetables are compared to each other in this respect. In the latter, in fact, growth is not confined within limits so strictly determined as in the former. Neither

the size of the body, nor the number of its constituent parts is fixed. Both art and culture may exercise the most marked influence on the growth of vegetables. In order to be convinced of this, it is sufficient to compare together two trees of the same species, one of which grows neglected in a dry and rocky soil, while the other is cultivated in a deep and fertile one. The first is small, its branches are short, and its leaves narrow; the other, on the contrary, majestically raises its trunk, which is crowned with long and vigorous branches, and adorned with a thick foliage. In animals, the size and general form of the body, and the number of parts which ought to compose it, are more fixed, and subject to fewer variations, while in vegetables it is almost impossible to find two individuals of the same species, which have an equal number of parts.

If we now turn our attention to the growth of vegetables in particular, we shall see that they are developed in two directions; that is to say, that, in proportion as their height increases, their diameter becomes more considerable. We have seen, in treating of the organization of the stem, that dicotyledonous and monocotyledonous trees differ widely in their internal structure, and that there are very striking differences between them. These differences clearly depend on the peculiar modes, according to which the vegetables of these

two great classes are developed. Accordingly, we shall treat separately of the growth of monocotyledonous and of dicotyledonous trees.

This part of vegetable physiology is unquestionably one of the most interesting, and yet it is one of those which are still involved in the greatest obscurity. In fact, all authors, particularly within a certain number of years, are far from being agreed respecting the manner of explaining the phenomena presented by the growth of the stem, particularly in dicotyledonous trees. The opinions on this subject are even so very different, that we deem it necessary to give them separate consideration.

§ *Of the Growth of the Stem of Dicotyledonous Trees.*

A. Of their growth in diameter.

All vegetables grow in diameter. It is sufficient to cast our eyes on the trees which grow around us, in order to be convinced of the truth of this proposition; accordingly no one has denied it. But by what mechanism does this growth proceed? On this point there is a considerable diversity of opinions. Among the various opinions which have been published by physiologists, we shall particularly distinguish the three following: 1°. Growth is carried on by the annual

change of liber into alburnum; 2°. by the developement of buds; 3°. by the cambium, which every year forms a distinct layer of liber and of alburnum. We shall here enter into a detailed account of them.

1°. *Growth in diameter is carried on in dicotyledonous trees by the annual change of liber into alburnum, of the alburnum into wood, and by the successive renewal of the liber.*

Such is the foundation of Du Hamel's theory, of that which the celebrated author has unfolded in his vegetable physics. We shall explain it in the fullest manner, because it is that which is most generally adopted, and almost the only one which has been professed publicly, at least in France.

We shall take the stem at its earliest developement, that is to say, when, by the effect of germination, it issues from the seed which contained it, and begins to appear externally.

All parts of the vegetable contained in the seed before germination, consist only of a dense and regular cellular tissue. The stem, like all the other organs, is wholly destitute of vessels. Properly speaking, there cannot be observed a trace of bark, pith, liber, &c. But scarcely has germination begun, and the stem acquired some developement, when spirals, false spirals, and porous

vessels are produced, and unite for the purpose of forming the walls of the medullary tube.

This inner part of the stem is the first that appears and is organized. The pith is contained within it; but it is still green, and is impregnated with a large quantity of aqueous fluid. In a short time, the outer surface of the medullary tube is observed to be covered with liquid cellular tissue. This is the first layer of cambium, which, on the one hand, goes to form the first liber, and on the other, the first cortical layer. This liber shall soon be converted into alburnum, in proportion as a new layer is organised to replace it. On the following year, the new liber will form a second zone of alburnum, and so on in succession, every year a layer of alburnum shall be converted into true wood, while the liber itself shall have acquired the properties and the nature of alburnum. This regular growth of the stem explains the formation of the concentric layers or zones, which are observed in a tranverse section of the stem of a dicotyledonous tree. But all these layers are not equally thick, nor is their thickness uniform in every part of the circumference. Careful observation will furnish an easy solution of this curious phenomenon. In fact, it has been observed, that the greater thickness of the woody layers corresponds invariably with the side where the roots are largest, and which, therefore, must have

drawn the greatest quantity of nourishment from the soil. Thus it is, for instance, that the trees situated on the edge of a forest have their woody layers always thickest on the outside, because, in fact, their roots, not meeting there with any obstacles, extend themselves in that direction, and acquire a fuller developement.

In this theory of Du Hamel we see that the liber performs the most important part in the formation of woody layers, inasmuch as it is annually changed into a new zone of alburnum, which is added to those that existed before.

The liber being the essential organ of vegetation, and changing every year its form and consistence, nature must have also provided the means of renewing it annually. This is what actually happens. If we carefully examine the successive growth of the divers organs which compose the stem of the dicotyledons, we shall find, in the first year, a gelatinous fluid between the cortical layers and the medullary tube, to which Grew and Du Hamel have given the name of cambium. This peculiar fluid contains the first rudiments of organization. In proportion as the young stem is developed, the innermost layer of this fluid becomes more consistent, is organized, hardened, and changes into liber, which after the first year is converted into a woody substance, which at first is soft and ill formed. Autumn comes, and vegeta-

tion is suspended in this state. The outer layer of the cambium, which has not as yet entirely changed its nature, remains stationary, and as it were torpid. Yet at the return of spring, when the genial heat of the sun awakens vegetables from their winter's sleep, the cambium resumes its vegetative power ; new buds and roots are developed, and when it has produced all the parts which are necessary for the support of vegetable life, it gradually hardens and becomes compact; in a word, it experiences the same changes with that which preceded it. But in proportion as these changes take place, as the liber is hardened and changes its nature, as the layer for which it has been substituted acquires greater solidity, a new liber is produced. From all points of the outer surface of that which is ready to be converted into wood, a viscid fluid exudes under the form of small drops, which spread and become united. This is new cambium, a new liber, which is to be organized and developed, and to pass through the same periods of growth with those which preceded it, and from which it has derived its origin. Such are the means employed by nature for the purpose of renewing annually the vegetating part of the stem. Here lies the great difference between woody and herbaceous stems. In woody stems, the tree is indebted for the duration and permanency of its vegetation, to the succes-

sive developement of new layers of liber. In herbaceous stems, on the contrary, the whole of the cambium is consumed in producing the different organs of the plant, and at the end of the year is wholly converted into a sort of dry and arid ligneous substance. There remains not, therefore, as in the woody stem, a certain quantity of gelatinous fluid, charged with the office of preserving from one year to the other the gems of a new vegetation, and the plant necessarily perishes for want of a proper substance to renew its growth.

After having unfolded, at some length, the theory of the formation of woody layers by means of the annual change of liber into alburnum, it becomes necessary to explain that which has been published by M. Du Petit Thouars, and which has been the subject of so much controversy among physiologists.

2°. *The successive formation of woody layers, that is to say, the growth of plants in diameter, is produced by the developement of buds.*

In the foregoing theory, the greater part of the phenomena of the growth of vegetables in diameter is attributed to the liber; here, on the contrary, the buds perform the most important part in that process. M. Du Petit Thouars having observed that buds are situated in the outer parenchyma, and that their fibres communicate with those of the scions or young branches which

support them, drew from it the following conclusions, which form the basis of his theory of vegetable organization.

1°. Buds are the first sensible phenomena of vegetation. In fact, all the parts which in vegetables are to be developed externally, are first contained in the buds. There is a bud in the axilla of every leaf, but this bud is apparent only in dicotyledonous plants, and among the monocotyledons, only in the family of the grasses. In the other monocotyledons, this bud is latent, and consists only of a vital point, capable in some circumstances of being developed like the buds of the dicotyledons.

2°. Buds, by their developement, produce scions or young branches covered with leaves, and very often with flowers. Each bud has an existence, in some respect, independent of that of the others. M. Du Petit Thouars considers them as analogous in their developement, and in their structure to the embryos contained in seeds, which, by the act of germination, produce a young stem, that may be justly compared to the scion produced by the developement of a bud. Accordingly, he gives to the latter the name of fixed or adherent embryos, in opposition to that of free embryos given to those that are contained within the seed. On examining the interior of these buds on a scion or young branch of one year old, they are

seen to communicate directly with the inner parenchyma or pith. Now this pith, as we have already stated, is at first green, and its cells contain a large quantity of aqueous fluids. It is from these fluids that the buds derive the first materials of their growth. They are, therefore, nourished at the expense of the inner parenchyma, and by absorbing the fluids contained in it, they dry it, and make it pass to the state of pith, properly so called, which is more or less opaque, or else diaphanous.

4°. As soon as these buds make their appearance, they obey two general motions, the one ascending or äerial, the other descending or terrestrial. Here it is that M. Du Petit Thouars compares the structure and uses of buds with those of embryos contained in seeds. He considers buds to be, as it were, germinating embryos. The layer of cambium situated between the bark and the wood, is to the bud what the soil is to the seed that begins to germinate. The part that expands in the air becomes a scion or young branch, while from its base, that is from the point by which it adheres to the mother plant, issue fibres, (compared by the author to the radicle of an embryo,) which gliding in the humid layer of cambium, between the liber and the alburnum, descend to the lower part of the vegetable. In their course downwards, these fibres meet with

those which descend from the other buds. They unite and anastomose, and thus form a layer of greater or less thickness, which becomes more consistent and solid, and forms annually a new layer of wood. With respect to the liber, when once formed, it never changes its nature; it is never converted into alburnum.

This theory is very ingenious, and M. Du Petit Thouars alleges many facts in support of its correctness. Thus, he says, that when a strong ligature is applied to the trunk of a dicotyledonous tree, a swelling is produced above it, and that the growth of the plant in diameter ceases below that obstacle. This swelling is occasioned by the ligneous fibres which descend from the base of the buds, and glide through the cambium which is situated between the liber and the alburnum. These fibres meeting with an insurmountable obstacle, are stopped in their progress and accumulated. From that moment, new layers of wood cease to be formed below the ligature, because the fibres destined for that use cannot arrive there. Such is the explanation given by M. Du Petit Thouars of the effects of the ligature, and of the circular swellings, which most authors explain in a manner wholly different. M. Du Petit Thouars refers also to the phenomena of grafting for the support of his theory. In grafting by inoculation, it is usual to take a bud which

is yet stationary, and to apply its base to the layer of cambium which is laid bare. The radicles or fibres which issue from the base of the bud, then glide between the bark and the alburnum, and the new plant is thus identified with that on which it is grafted.

I have seen with M. Du Petit Thouars a very valuable preparation, which seems to furnish a strong argument in favour of his theory, and of which he has given a very good figure in a collection of memoirs which is printed, but, I believe, not as yet published. It is a branch of robinia pseudacacia, on which a young shoot of robinia hispida had been grafted. The stock died, but the graft having continued to vegetate, there is seen issuing from its base a kind of slope, composed of very distinct fibres, which embrace the extremity of the branch to a great extent, and form around it a species of tube. In this example, there is the clearest evidence, that the fibres descend from the base of the graft in order to spread over the stock.

Notwithstanding all the arguments adduced by the author in favour of his theory, it has not as yet been wholly adopted by any physiologist. On the contrary, all those who attend to vegetable physics, have more or less controverted it. The principal arguments which have been opposed to the theory of M. Du Petit Thouars, are, 1°.

That there is no clear proof that the fibres which form a communication between the buds and the stems that support them, descend, as is represented, from those buds to the roots; but to this M. Du Petit Thouars replies, that the buds are indeed the origin of the ligneous fibres, but that they do not furnish all the materials of their elongation. When once they have issued from the base of the buds, they are immersed in cambium, from which they absorb every thing necessary for their growth. 2°. That the phenomena of the circular swelling produced by the ligature on the trunk, may be explained by the interruption and stagnation of the descending sap. But, says M. Du Petit Thouars, the experiment of Hales, which has been repeated by Du Hamel, will answer this objection. Having, by the removal of three circular rings, completely isolated two cylinders of bark, one of which possessed a bud and the other not, it followed that the circular swelling appeared only on the first, a clear proof that the ligneous fibres originate from the buds. 3°. That it is impossible to conceive how such slender fibres as those which unite buds to stems, can in so short a space of time, as that in which the stem grows in diameter, descend by their own weight from the top of a stem of 60 or 80 feet high to its root. As it is not the opinion of the learned academician, that the fibres issue and de-

scend completely formed from the base of the buds, but that, on the contrary, they are formed while traversing the layers of cambium, this objection falls of itself to the ground. 4°. That, since the fibres which descend from the base of the buds are those that form the woody layers, if in grafting by inoculation, buds belonging to a tree of coloured wood, be inserted on a stock of white wood, the fibres which issue from those buds ought to retain their colour, and the new layers composed of them ought to possess that colour, which, however, is not the fact. This objection being one of those which has made the greatest noise, is also that which the author has refuted with the greatest ease; for the objection has been made, because his opinion was not clearly understood. In fact, as the author has repeatedly observed, the fibres issuing from the base of the buds are fed by the cambium of the branch on whose surface they are formed. Now, in the case of grafting on two stocks whose wood is of different colours, when the new fibres are immersed in the cambium of that which has coloured wood, they acquire and retain the shade which is natural to them; when, on the contrary, they are formed at the expense of the cambium of that which has a clear colour, they acquire the tint peculiar to this new wood. 5°. Lastly, if the formation of wood be owing to the developement

of buds, how is the first layer formed on the young shoot of one year old, when none of its buds are yet developed? According to the celebrated academician, whose theory we are here expounding, as soon as the bud is developed in order to form a shoot, the leaves which compose it are separated from each other, and leave spaces between them which are called merithalli. If at this period we examine the internal structure of the young shoot, it will be seen that from the base of each leaf there proceeds a bundle of fibres whose union constitutes the medullary tube. But in proportion as the leaves are developed, a bud appears in the axilla of each of them, which tends to establish a communication with the root by the production of woody fibres. It is these then that gradually cover the medullary tube and make it a continuous layer.

The two theories, therefore, which we have now explained, cannot be adopted in all their parts, as furnishing a satisfactory explanation of all the phenomena of growth in diameter of dicotyledonous vegetables. In fact, that of Du Hamel is essentially founded on the annual change of liber into alburnum, and its re-production by means of the layer of cambium. The experiment in which this celebrated naturalist says, that having passed a silver wire into the liber, he found it, on the following year, in the alburnum, is quite

fallacious. In fact, all those who after Du Hamel tried to repeat the experiment, failed in obtaining the same result; and when the silver wire was really passed through the liber, it was always found again in that organ, and never in the alburnum.

3°. *The annual formation of woody layers is owing to the cambium, which, every year, forms at one and the same time, a new layer of alburnum and a new layer of liber.*

This is the opinion which has been latterly professed by Mirbel, and which appears to us to unite in its favour the greatest number of probabilities.

The liber, which has been heretofore considered as the essential organ of vegetation, as that which effected annually the growth of dicotyledonous trees in diameter, being on the contrary neutral and passive in that process, a different explanation of the phenomena of growth in diameter is rendered necessary. Now, the following appears to us to be the most probable, and the most conformable to an accurate observation of facts. If a young branch be examined during the period of vegetation, that is to say, when the sap circulates copiously in all parts of the vegetable, the following phenomena are observed: between the liber and the alburnum there is found a layer of fluid, at first clear and limpid, which gradually thickens

and becomes more consistent. This fluid or cambium is composed of the descending sap, mixed with a part of the proper juices of vegetables. In proportion as the cambium thickens, filaments are seen to form within it. It soon becomes organized, and acquires the appearance of vegetable tissue; this change is gradual, and continues during the whole time that the buds are growing, so that the formation of the annual layer proceeds in a slow and progressive manner.

This is the reason that the new layers of alburnum often exhibit several concentric zones, which shews that their whole thickness has not been formed at once.

Thus then, the alburnum is not formed by the liber which thickens and becomes more consistent, but by the cambium which is organized and thus becomes the means of growth in diameter, giving rise annually to the formation of a layer of alburnum and of a layer of liber, both distinct from each other, although produced by the same organ. When Du Hamel found in the alburnum the silver wire which he thought he had passed through the liber, it was because it had been really engaged in the organized layer of cambium. From this it also follows, that the liber every year grows thick by its inner surface. In fact, the layer of cambium that bathes its inner surface, becomes organized, and is added to this organ, so that it

gradually acquires greater thickness. This is the reason that the liber consists of several plates or leaves united together by a very fine layer of cellular tissue.

Thus then, to recapitulate, there is every year formed in the trunk of dicotyledonous trees a new layer of wood. This layer is produced by a part of the cambium which becomes organized and solidified. The alburnum formed on the preceding year acquires greater density, and is changed into wood. But the liber undergoes no change; it is only repaired and increased on its inner surface by means of the cambium, which successively forms new layers. It appears to us, that the growth in thickness of dicotyledonous stems is effected by the mechanism which we have now described. We shall next describe their growth in height.

B. Growth in height.

At the time of germination, the radicle descends into the earth, while the caudex ascendens rises towards the heavens. The first layer of cambium becomes organized, and obeys this impulse. Towards autumn, when converted into alburnum and into liber, its growth is arrested. At the return of spring, when vegetation is renewed, the vegetable tissue is gorged with nutritious fluids, which vivify the buds. From the upper part of the stem proceeds a new centre of

vegetation, from which arises a young shoot, that experiences the same changes, in its developement, with the former. To this second succeeds a third, which on the following year is surmounted by a fourth, and so on.

The trunk is, therefore, composed of a series of cones, greatly elongated, whose apices are turned upwards, and which are placed the one above the other. But the apex of the innermost cone terminates at the base of the second shoot, and so on in succession; so that the number of woody layers corresponds with the number of years that the plant has lived, only at the base of the trunk. Thus, for instance, a stem of ten years old will have ten layers of wood at its base. It will shew only nine when cut at the second shoot, only eight at the third, and lastly, only one near the top. This is the reason that the trunk of dicotyledonous trees is more or less conical, the number of woody layers being gradually increased towards the root.

There are some trees in which this mode of growing in height is exceedingly manifest; for example, pines and firs. At the end of the first year, a conical bud is observed at the top of the stem, from which arises a whorl of young branches, at the centre of which there is one that shoots up vertically. This is the one which is destined to continue the stem. From its top, at the end of

the second year, proceeds a bud similar to the former, which will exhibit the same phenomena in its developement. Thus, in these trees, the number of their years may be known by the number of whorls of branches that appears upon their stem.

§ 2. *The Growth of the Stems of Monocotyledonous Trees.*

On examining the growth of the stipe of a palm, we find it to proceed in the following manner:

After germination, the leaves, which are usually folded, become expanded, and appear under the form of a circular cluster which springs from the collar of the root. On the second year, a new cluster springs up from the centre of the former, and pushes outwards those that existed before. Then the oldest begin to wither, to dry, and to fall off. But their bases, adhering intimately to the top of the root, remain, are persistent, and form by their union a solid ring, which becomes the base of the stipe. A new central bud being developed every year, the outer leaves of that which preceded it fall off, and their base, which is persistent, forms a new ring, which is superadded to those that already existed.

Such is the developement of the stems of

monocotyledons. Their stipe, instead of being formed of concentric layers like the trunk of the dicotyledons, is composed of rings placed above one another. Hence it is clear, that the stem of the monocotyledons ought to grow but very little in thickness. In fact, its lateral growth cannot proceed, except in cases where the persistent base of the leaves has not as yet acquired sufficient solidity and hardness to resist the excentric pressure produced by the bud. Accordingly, we see that the palms, which are sometimes 120 and 140 feet high, have a stem which is often scarcely a foot in diameter.

In dicotyledonous trees, the cambium is the essential means of increasing the stems, because it is that which every year becomes organized and forms a new layer of wood. Here, on the contrary, the terminal bud which crowns the stipe, performs the same office. Accordingly, the tree would inevitably perish, if this centre of vegetation were removed. If we compare, in a general way, the growth in diameter of the stem of dicotyledonous trees with that of the monocotyledons, we shall find that they differ not less than their anatomical structures. In fact, in dicotyledons, there are two distinct systems; the central system, composed of the medullary tube, and of the ligneous layers, and the cortical system, consisting of the bark. These systems grow separately, so

that there are two surfaces of growth in this class of vegetables. The central system grows by the new layers which are added to its outer surface, and the cortical system, on the contrary, grows by its inner surface.

But in monocotyledonous vegetables there is only a single surface of growth, and therefore but a single system. M. Them. Lestiboudois, Professor of Botany at Lille, very justly remarking that in this single system, which forms the stem of the monocotyledons, the growth is carried on at the inner surface, draws from it the conclusion that this system is the cortical one, and that the central system is wanting. From this it follows that the stipe of the palms is organized like the bark of the dicotyledons. From these different considerations, we are warranted to lay down this principle, namely, that the stipe of the palms and of the other woody monocotyledons, differs essentially both in its organization and in its mode of developement, from the trunk of dicotyledonous vegetables. We may even go farther, and say, that the stipe differs so much from the trunk in its first origin and mode of developement, that it is not at all wonderful, that its internal organization, which is only the result of this mode of developement, should so widely differ from that of the woody stem of dicotyledonous trees. For let us consider the mode of formation and growth of an

oak, or of any other dicotyledonous vegetable. The seed germinates, the radicle sinks into the earth, the caulicle, or the organ which represents it, that is to say, which supports the gemmule and raises it above the base of the radicle, becomes erect; in a word, at the very commencement of vegetable life, the organ which is to constitute the stem, already exists under the form of a cylinder, which is more or less elongated, composed internally of a cellular tissue that represents the pith, and externally of tubes or of fibres, the first rudiments of the wood, of the bark, and in general of all the filamentous parts of the stem. Let us now examine, by way of comparison, the seed of a palm at the time of its germination. Its radicular extremity becomes more or less extended, and bursts at the top, to give exit to the radicle which was first imprisoned within a kind of close sheath, called coleorhiza, which it tears, for the purpose of sinking into the earth, and of becoming the root. The opposite extremity to the radicle, that is to say, the cotyledon, becomes slighty enlarged, but is soon seen to slit open on one side beneath its summit, and through this slit or opening there issues a more or less considerable number of leaves enclosed within each other. But in this embryo of the palm, we do not perceive, as in that of the oak, of the lime tree, of the pine, &c. a caulicle or rudiment of a stem. The organ to which this

name is subsequently given, is to be gradually produced at the expense of another organ. In fact, as we have already explained, the bases of the leaves successively developed, which are approximated to each other, in consequence of the pressure made on the outer leaves, in proportion as new ones are produced within, become united, and ultimately form a sort of fleshy plate, composed of cellular tissue and traversed by scattered fibres. What is called stipe or trunk in a palm, is, therefore, an organ composed of a great number of scales, which are nothing but the bases of leaves more or less united, and having within a central and terminal bud, which is the essentially vegetating organ. Thus then, the stipe of a palm is not really a stem, either in its origin, in its developement, or in its organization. Let us see if something analogous do not appear in the series of other vegetables. And, in the first place, what is the pretended subterraneous stem, commonly called root, in most of the species of the genus iris? It is a fleshy body, having a few longitudinal fibres within it, and presenting on its outer surface the marks of the scales which compose it. Now, if we pursue its developement, we shall see that it owes its formation to the persistent bases of leaves, whose upper part is destroyed, which have united and formed the fleshy body, that in the irides is usually designated by the names of

root, of rhizoma, of stock, or of subterraneous stem. This organ, therefore, as well as the stipe of the palms, is really neither a root nor a stem, but an union of the bases of leaves all collected into one mass. One species of garlick (allium senescens) has a perfectly analogous organ, that is to say, a stock which is more or less fleshy and branched. Now, from this stock of the allium senescens, and of the irides, to the solid or scaly bulbs of the lilies, there appears to us to be but a very slight transition. A bulb, in fact, is nothing but an organ composed of scales which are various in their forms and dispositions, but always situated on a fleshy plate and covering a central and terminal bud. These scales are always nothing but leaves, whose base alone is developed, or whose base continues permanent, while the upper part is destroyed. If, as has been proved, the subterraneous stem of the iris has the same origin, the same mode of developement, and the same organization with the stipe of the palms, and if, on the other hand, we have demonstrated that in many respects, there is no sensible difference between the pretended stock of the irides and the bulb of most of the lilies, the conclusion appears to us inevitable, that the stipe of the palms, instead of being a stem, is really nothing but a bulb. This opinion may appear paradoxical to those who do not leave out of consideration the general form,

the magnitude and hardness of the stipe of the palms, compared with the bulbs of the other monocotyledons. But, if we consider that these different attributes are not essential to the nature of this organ, that they are frequently wanting in a great number of species, that, moreover, the stipe in some, instead of being long and cylindrical, is short and scarcely perceptible, and sometimes consists only of a kind of bulbiform swelling, that in other species the stipe, instead of being hard and woody, is soft, fleshy, and easily incised with a cutting instrument, these differences, which at first appeared so striking, will vanish in a moment.

If, on the other hand, we examine the origin, the mode of formation and of developement of the stipe, compared with those of the bulb, we must necessarily conclude that these two organs are the same.

According to this mode of viewing the stipe, we can very easily explain how it happens that this organ is so seldom divided into branches. In fact it is known, that a branch is always produced by the elongation of a bud, which is usually placed in the axilla of a leaf. Now, in the monocotyledons, these axillary buds almost always prove abortive, or remain in the rudimental state, as, for instance, in most of the grasses. It is the same in the palms; their axillary buds generally remain

in the rudimental state, and then the stipe is perfectly simple; but occasionally some of the buds receiving more nourishment than the others become developed, that is to say, the leaves that compose them, by uniting at their base form a new stipe springing from the old. This is what may be observed, for instance, in certain species of yucca, in the cucifera thebaica, &c.

In order to conclude what relates to the growth of the stem in vegetables, we have only to make known the result of the observations recently published by M. Du Trochet, (Mem. du Museum, V. vii. and viii.) Heretofore it was generally admitted, that growth in diameter was the effect only of the new layers, which are annually formed between the liber and the alburnum. M. Du Trochet has proved, that the growth of vegetables in diameter, is effected in two ways, namely, in thickness by the formation of new layers between the alburnum and the liber, and in width, by the lateral developement of the new layers, and the formation of new bundles of fibres. This growth in thickness and in width takes place both in roots and trunks. It is necessary, however, to remark, that Professor Link was the first, who, in his Anatomy of Plants, and more recently in his Botanical Philosophy, established the growth of the stem, not only from the centre to the circumfe-

rence, but also laterally by the multiplication of the vascular bundles.

M. Du Trochet tried his first experiments on the stem of the traveller's joy (clematis vitalba.) When the extremity of one of its young branches is cut across, it is found to contain six bundles of longitudinal fibres, which are separated by medullary rays or spaces, that are rather wide. As vegetation proceeds, there is gradually formed in the centre of each of the medullary spaces, a new bundle of longitudinal fibres, which soon acquires the same size with the six primitive bundles, so that at the end of the first year, the stem is composed of twelve bundles of fibres, separated by an equal number of medullary rays.

During the second year, each of the six primitive bundles is divided into three, by the median production of a new bundle of longitudinal fibres, which is separated from those between which it is formed, by two incomplete medullary rays not reaching to the central pith; on the other hand, the six secondary bundles of the first year are each divided into two, by the median formation of a new incomplete medullary ray. From this it follows, that at the end of the second year, there are thirty bundles of fibres, separated by an equal number of rays or medullary spaces, of which only twelve are complete, namely, those which existed at the end of the first year, and

establish a direct communication between the outer and the inner pith.

If we carefully study the manner in which the longitudinal bundles of fibres are multiplied, we shall see that the growth proceeds in a lateral direction. In fact, the median production of new bundles of fibres in the centre of the medullary rays, or that of medullary rays in the centre of bundles of fibres, must necessarily distend them laterally, and therefore increase the width of the circular layers in which the developement takes place. This lateral dilatation had never been noticed before the able experimenter, whose observations we have here made known.

The growth in width of the parts in question is at an end as soon as they are solidified. Thus, it ceases in the woody layers, but is continued in the bark, which, in this manner, permits the growth in diameter of the layers of wood. The roots also grow wide, as has been already mentioned; but in this organ, the growth always begins by the median production of new medullary rays in the centre of the bundles of fibres. At a later period these new medullary spaces are themselves the seat of the developement of other bundles of fibres.

From what has been already stated, it may be seen that the organic elements of vegetables have a natural tendency to the median production.

Thus, there is a tendency to the production of new medullary rays in the centre of bundles of fibres, while on the other hand, the new bundles of longitudinal fibres are produced in the centre of medullary rays.

We have made known the author's opinion respecting the growth of the stem in width; we must now explain his ideas in regard to its growth in thickness. The layers of wood of new formation, which are annually produced, are separated from the old by a thin layer of central pith. These layers of pith, which separate from each other the layers of wood, are not always easily perceived; but they are very distinct in some trees, for example, in the rhus typhinum, where their deeper colour enables us at once to distinguish them from the layers of wood, which are of a lighter shade. In spring, the growth in thickness always commences by the formation of that thin layer of cellular tissue or of pith. In virtue of its property of producing longitudinal fibres, the layer of pith soon gives birth to vessels which surround it, and thus form a kind of medullary canal, destined at a later period to become the new layer of wood.

In this theory, we see the important office which the author ascribes to the pith. In fact, it is the essential cause of growth in diameter, inasmuch as it produces the vessels which are afterwards to constitute the new layer of wood.

The same phenomena take place in the liber; each of its layers is separated by a thin layer of cellular tissue, which belongs to the cortical pith, and which is the agent of its annual growth.

The Theory of certain Processes for the artificial Multiplication of Vegetables, explained by the Laws of vegetable Physiology.

THE most natural and the easiest means of multiplying vegetables, is without question, by the germination of seeds; it is that by which the vegetables scattered over the surface of the globe are naturally renewed. But there are others also, which the art of culture frequently employs to perpetuate, and to multiply certain races or varieties of trees, which cannot be re-produced by the means of seeds. The processes in question are those by layers, by slips, and by grafting.

Propagating by layers, is an operation whereby the base of a young branch is surrounded with earth, and made to throw out roots before it is separated from its parent stem. Sometimes the operation is performed on the lower branches of a young shrub; they are bent downwards and laid along the ground: sometimes the upper branches are made to pass through a vessel full of mould. In order to facilitate the process, it is usual to make an incision at the base of the young branch,

or to pass a ligature round it, to favour the formation of roots. This mode of propagation is employed for the multiplication of a great number of vegetables, such as pinks, hortensia, heaths, gooseberry, &c.

Propagating by slips or cuttings, differs from that by layers in this respect, that the young branch is separated from the parent stem before it is planted in the earth. There are some trees, whose cuttings strike root with great facility. In general, such as have a white and light wood are the best adapted for this mode of propagation. Thus, a willow branch, or that of a poplar or lime tree, if planted in the earth, will shortly strike root, and soon after it will vegetate with vigour. A slip will succeed with greater certainty, if the planter use the precaution to leave two or three buds under ground, that is to say, on the lower part of the young branch.

Very often a ligature is applied, or an incision is made at the lower part of a cutting, in order to secure its success. Sometimes even a longitudinal slit is made at the base, into which is inserted a small humid sponge.

There are woody species of vegetables, which it is very difficult to propagate by cuttings; such as pines, firs, oaks, heaths, and in general, all those whose wood is very dense or resinous.

Grafting is an operation whereby a young bud or

shoot is inserted on a plant, where it becomes developed, and is identified with the stock on which it is grafted. Grafting can succeed only between parts which are in a state of vegetation ; thus it is, for instance, that it cannot take effect either in wood or in alburnum. The operation of grafting and its phenomena, are particularly remarkable for shewing the analogy between buds, or gems, and seeds, especially in regard to their developement. In fact, both these organs are destined to produce new individuals, the one living at the expense of the plant on which they are developed, whilst the others subsist of themselves, without any external aid.

It is necessary to remark, that grafting or the union of parts cannot take place, except between vegetables of the same species, or species of the same genus, or lastly between genera of the same family ; but never between individuals belonging to different natural orders. Thus, for instance, the peach tree may be grafted on that of the almond, the apricot tree on that of the prune, the pavia on the horse chesnut ; but this operation can never succeed between the latter, for instance, and the almond tree. It is necessary that there should be a kind of adaptation or analogy between the sap of the two individuals, in order that the union of the graft may be effectuated.

The union of grafts is effected by means

of the cambium, or proper juices of vegetables. This fluid substance serves as a means of union between the graft and the stock, as in animals the coagulable lymph is effused between the edges of a recent wound, which it unites and approximates. On examining the wound of a graft, about fifteen days after the operation, there is seen, between the two parts in contact, a thin layer of small greenish granulations, scattered in a viscid fluid. These small granulations, the rudiments of vegetable organization, are produced by the cambium, which is solidified and organized, an effect which is produced whenever a superficial wound is made in a tree, and protected from the contact of air.

The art of culture derives many advantages from this means of multiplication. 1°. It enables us to preserve and to multiply remarkable varieties or monstrosities, which cannot be re-produced by the means of seeds. 2°. To raise quickly a great number of interesting trees, which it is difficult to multiply by any other means. 3°. To expedite, by many years, the fructification of certain vegetables. 4°. To improve and to propagate the varieties of fruit trees, &c.

Professor Thouin has published an excellent monograph on grafting, in which he refers all the known processsess to the following heads: 1°. Grafting by approach. 2. Grafting by scions.

3. Grafting by buds. 4. The grafting of herbaceous vegetables.

SECTION I.

GRAFTING BY APPROACH OR IN ARCHING.

It is executed between two plants growing by the root, which it is proposed to unite and to incorporate by one or more points of their extent. For this purpose, wounds, that exactly correspond to each other, are made in the parts which it is intended to unite. By removing plates of bark of equal dimensions, these wounds are united; they are kept together, and guarded from the contact of air.

By this process, stems, branches, and roots may be grafted on each other, and fruits and even flowers on leaves.

SECTION II.

GRAFTING BY SCIONS.

Grafting by scions is performed with young branches, or even with roots, which are removed from one plant to be placed on another, in order to live and grow at its expense. In general, the young twigs which are to be grafted, are separated

a few days, sometimes even many months, before the operation is performed, in order that they may contain less sap than the stock on which they are to be placed. Care is taken, in this case, to preserve them by keeping their extremities in water or in the earth.

Before this species of grafting is performed, it is usual to cut off the head of the stock, and sometimes it is removed even on a level with the surface of the earth, particularly for trees which must be buried under the earth, such as the vine, &c.

We must observe, that a necessary condition for the success of this species of grafting is, that the liber of the shoot should coincide, in the greater part of its extent, with that of the stock on which it is inserted.

Grafting by scions is performed in various ways. Sometimes the head of the stock is cleft in two, and the twig to be ingrafted is introduced into this cleft. This species is known by the name of cleft grafting. Sometimes the bark is removed from the subjacent wood, and several small twigs are placed between them, disposed in a circular order. This is called crown grafting. At other times, the trunk of the tree is bored, and a young branch is introduced and secured in the hole. This mode, which is now seldom employed, is known by the name of wim-

ble grafting. Sometimes grafting by scions is performed with branches covered with leaves, flowers, and even with young fruit. In this case, it is effected during the full flow of the first sap. By this process, it is no uncommon thing, says M. Thouin, to obtain fruit from a tree, fifteen or twenty years sooner than it could otherwise produce them. It has even happened, by this process, that a seed, which was sown early in the season, bore fruit, before the end of the year, which was perfectly ripe.

Grafting by scions is also performed without cutting off the head of the stock. An incision is made in one side of the stem, and the graft is applied to it. This mode, which is practised for the purpose of furnishing anew the head of a tree, which has lost some of its branches, is called side grafting.

Lastly, we may refer to this section, the grafting which is performed with a young shoot, on a root left in its situation, or with one root upon the root of another individual.

SECTION III.

GRAFTING BY BUDS.

This consists in transferring from one plant to another a plate of bark, bearing one or more

buds. To this section belong grafting by escutcheon, flute grafting, &c. This species of grafting is the most generally practised, particularly for mutiplying fruit trees. In fact, it can be easily and expeditiously performed. It may be performed in spring when the sap is ascending, or during the flow of the sap in August. The shape of the graft and of the incision will vary exceedingly, according to the process adopted in performing it.

SECTION IV.

GRAFTING OF THE HERBACEOUS PARTS OF VEGETABLES, OR THE TSCHOUDY GRAFTING.

THE discovery of this species of grafting dates from a very recent period. It is only a few years since it was first practised by its inventor, the Baron De Tschoudy. It may be performed with the young herbaceous shoots of trees, during the full flow of the sap, or with annual plants. In order that this graft may succeed, it is necessary to insert it in the axilla or neighbourhood of a living leaf. The leaf serves to attract the sap to the graft, and to facilitate its union and developement. The modes employed in performing this operation, are nearly the same as in the other

species of grafting. Such are the different species of grafting employed for the multiplication of vegetables. It is no part of our subject to describe the numerous and various processes, by which they are reduced to practice. For this purpose, we refer our readers to treatises on agriculture, and particularly to the monograph published by M. Thouin in the year 1822.

Of the Height of Trees.

Trees are, in general, the stronger and the loftier, as the soil and situation in which they grow are better adapted to their nature, and more favourable to their growth. A certain degree of moisture, together with a considerable degree of heat, appear to be the circumstances most favourable to the growth of trees. Accordingly, they attain to the greatest height in climates which possess these conditions of the atmosphere. The forests of South America are, in general, full of trees, which in their port, their loftiness, and in the beauty of their foliage and of their flowers, far surpass those of our more temperate climates. There are certain trees, which require a long series of years to arrive at any considerable height or magnitude; such, for example, are the oak, the elm, and the cedar. Others, on the contrary, acquire a more rapid growth, in a much

shorter time. They are chiefly those whose wood is light and tender, such as poplars, firs, acacias, &c. Lastly, there are certain plants which grow so rapidly, that the progress of their developement may, as it were, be seen with the eye. The agave Americana is of this number. This plant, which I have seen lining the rocks that border the Mediterranean, in the Gulf of Genoa, shoots up, when blowing, in the space of thirty or forty days, and sometimes sooner, a scape which often attains to the height of thirty feet. As it thus grows nearly a foot every day, we may conceive the possibility of its growth being visible to the eye of the observer.

In general, the greatest height that our forest trees can attain to, is from 120 to 130 feet. In America, the palms and several other trees often surpass 150 feet.

Of the Thickness of Trees.

The thickness of trees is not less various than their height. Some of them occasionally grow to a monstrous size. We shall not here speak of the famous chesnut tree of Mount Etna, which, by the accounts of travellers, is 160 feet in circumference, because it is admitted to consist of several trunks united into one; but we may quote as well established instances of enormous magnitude,

the baobabs observed by Adanson in the Cape Verd islands, some of which were 120 feet in circumference. In our own climate, there are oaks, elms, lime trees, apple and pear trees, which are from 25 to 30 feet in circumference.

Of the Duration of Trees.

Trees planted in a suitable soil, in a situation adapted to their nature, may live for centuries. Thus, the olive may live 300 years, the oak nearly 600. The cedars of Lebanon appear to be indestructible. According to very ingenious calculations, Adanson estimates that the baobabs, of which we have lately spoken, might be nearly 6000 years old.

The age of a dicotyledonous tree may be known by the number of woody layers which it exhibits in a transverse section of its trunk. In fact, as there is every year formed a new layer of wood, it is obvious, that a tree of 20 years old, for instance, ought to have at its base only 20 concentric zones of wood, and so on in succession.

The Uses of Stems.

Wood is employed for so many various purposes in domestic economy and in the arts, it is of such indispensable necessity for building, both by

sea and land, for the construction of our machines and instruments, that no part of the plant can dispute with it a superiority in this respect.

Many herbaceous stems are used as food, both by man and beast.

The stem of the saccharum officinarum supplies the greatest part of the sugar diffused in commerce, which is therefore called cane sugar.

Several species of wood are employed in dying; such as saunders wood, logwood, Brasil wood, &c.

The bark of the oak, and, in general, of all those that contain a large quantity of tannin and gallic acid, is used in tanning leather.

In regard to their medicinal virtues, stems, woods, and barks, occupy the first rank in the materia medica. Every one knows, that to this class of organs, are referred the different species of Peruvian bark, cinnamon and Winter's bark, sassafras and guaiacum, and a great many other medicines, which enjoy a well deserved reputation.

CHAPTER III.

OF BUDS.

UNDER the general name of buds, we include 1°. Buds properly so called. 2°. The turio. 3°.

The bulb. 4°. The tubercle. 5°. Bulbils, which we shall now describe in succession.

§ 1. *Of Buds, properly so called.*

Buds, properly so called (gemmæ,) are bodies of various forms, natures, and aspects, generally composed of scales closely imbricated, and containing within the rudiments of stems, of branches, of leaves, and of the organs of fructification. They are always found upon branches, in the axilla of the leaves, or at the extremity of the twigs. They are ovate, conical, or rounded, composed of scales placed the one over the other and imbricated, covered externally, in trees of our climate, with a viscid resinous substance, and having within a close downy texture, which is destined to defend the organs contained in them from the winter's cold. Accordingly, no provision of the kind is made for trees of the torrid zone, nor for those which are kept in our green houses. But vegetables, which are not possessed of them, cannot endure the severity of our winters, and would inevitably perish if they were exposed to it.

Buds begin to appear in summer, that is to say, at the period when vegetation is in its greatest vigour and activity; they are then called eyes. They grow a little in autumn, become buds, and

remain stationary during winter. But at the return of spring, they participate in the general impulse which is communicated to the other parts of the vegetable. They become expanded and enlarged. Their scales are separated, and give exit to the organs which they protected, and it is only then that they are properly called buds.

The scales, which constitute the external covering of buds, are not all of the same nature, or of the same origin. The only common point of resemblance between them, is, that they are always abortive and imperfect organs. Thus they are sometimes leaves, petioles, or stipules which have not reached their full developement, but which, however, in some circumstances grow, are expanded, and thus reveal their true nature.

Buds are divided into the naked and the scaly. The first are those which have no external scales, that is to say, all whose parts become developed. Such are those of the greater part of herbaceous vegetables.

On the contrary, we call those scaly buds, whose outer part is formed of more or less numerous scales, as may be observed in the trees of our climate.

According to the organs of which the scales are composed, the scaly buds are distinguished into :

1°. The foliaceous (gemmæ foliaceæ,) those

whose scales are only abortive leaves, which are often capable of expanding, as in the daphne mezereon.

2°. Petiolaceous (gemmæ petiolaceæ,) when their scales consist of the persistent bases of petioles, as in the walnut (juglans regia.)

3°. Stipulaceous (gemmæ stipulaceæ,) when the stipules, by uniting, form a covering for the young shoot, as may be observed in the hornbeam (carpinus sylvestris,) in the tulip tree (liriodendrum tulipifera) and particularly in certain species of figs, as in the ficus elastica and many others.

4°. Fulcraceous (gemmæ fulcraceæ,) when they are formed of petioles furnished with stipules, as in the plum tree.

Buds are, in general, visible externally long before their expansion. There are certain trees, on the contrary, in which they are engaged as it were in the substance of the wood, and appear only at the commencement of their developement. Such are the acacias (robinia pseudacacia, L,) and many other leguminous vegetables.

Buds may be either simple, that is to say, producing only a single shoot, as in the lilach, the oak; or compound, that is to say, containing several stems or branches, like those of the pines.

According to the parts contained in them,

buds are moreover distinguished into floriferous, foliiferous and mixt.

1°. The floriferous or fructiferous bud (gemma florifera seu fructifera,) is that which contains one or more flowers without leaves. In general, they are pretty large, ovate and rounded, as in the apple and pear trees, &c.

The foliiferous bud (gemma foliifera,) contains only leaves, such as that which terminates the stem of the daphne mezereon.

3°. Lastly, they call that a mixt bud (gemma folii-florifera,) which contains at once both flowers and leaves, as in the lilach. Cultivators are never mistaken respecting the nature of a bud, which they generally recognize in fruit trees by its form; thus, the flower bud is conical and swelled; that which contains only leaves is, on the contrary, slender, elongated, and pointed.

§ 2. *Of the Turio.*

THE name of turio is given to the subterraneous buds of perennial plants; it is that which by its developement annually produces the new stems. Thus, the part of the asparagus which we eat, is the turio of the plant of that name. The difference between the bud, properly so called, and the turio is, that the latter always grows from a perennial root, or from a rhizoma, that is

to say, it has a subterraneous origin; while the other always grows on a part which is exposed to the air and light.

§ 3. *Of the Bulb.*

The bulb (bulbus) is a kind of bud belonging to certain perennial plants, and particularly to the monocotyledons. We have already seen, in speaking of bulbiferous roots, that it is supported by a species of solid horizontal scale, which lies between it and the true root. To this flat tubercle, are attached by their base the fleshy scales which form the outer part of the bulb. Within, it contains the rudiments of the scape and of the leaves. These scales are thick, fleshy, and succulent, in proportion as they are nearer to the centre of the bulb. The outer scales, on the contrary, are dry, thin, and nearly of the consistence of paper.

Sometimes these scales are composed of a single piece, and are enclosed within each other, that is to say, that each scale embraces the entire circumference of the bulb, as in the common onion (allium cepa,) in the hyacinth (hyacinthus orientalis.) They are then called tunicated bulbs (bulbi tunicati.) (See Pl. 2. fig. 7. 7. a.) At other times these scales are smaller, and free at their sides, and they cover each other only par-

tially like the tiles of a house: for example, the lily (lilium candidum.) In this case, they constitute the scaly bulbs (bulbi squamosi, imbricati.) (See Pl. 2. fig. 2.) Lastly, sometimes the tunics which constitute the bulb are so closely pressed together, that they cannot be distinguished, and then it appears to be formed of a solid homogeneous substance. This bulb bears the name of solid bulb (bulbus solidus:) for example, crocus sativus, colchicum autumnale, gladiolus communis. Here we shall take occasion to remark on the gradual transition from the bulb, properly so called, to the true tubercle. In this we shall at once find the proof and confirmation of the principle we have already laid down, namely, that tubercles, which have been so long considered as roots, are nothing but true buds. No one, in fact, will question the propriety of considering as true buds the scaly and tunicated bulbs, and even the solid bulbs of colchicum and of crocus, &c. Now we ask, what difference is there between these solid bulbs and the two tubercles of the orchideæ, or those of the potato? If in the one case a particular name is given to one of these organs, wherefore give a different name to a part which is perfectly similar to it, in its structure and its uses?

Bulbs have, in general, an ovate or a globular form. Sometimes, however, they are more or less

elongated, and somewhat cylindrical, as may be observed in some species of allium. In the banyans, the bulbs are greatly elongated, cylindrical, and of the form of a stem. We have already advanced the opinion, and defended it, that the stipe of the palms, of the dracænas of the yuccas, &c. is a true bulb.

The bulb is sometimes simple, that is to say, consisting of a single body, like that of the tulip, of the squill, &c. Or it is multiple, that is to say, that several small bulbs are found united under the same integuments, in which case they are called off-sets: for example, in the garlick (allium sativum.) Bulbs being the buds of certain perennial plants, must be re-produced every year; but this is not effected in the same manner in all species. Sometimes the new buds grow in the very centre of the old, as in the common onion (allium cepa,) at other times from the lateral part of their substance, as in the meadow saffron, ornithogalum minimum, &c., or else the new ones are produced at one side of the old, as in the tulip, the hyacinth, or above them, as in the gladiolus, or below them, as in a great number of ixias, &c.

In proportion as a bulb shoots up the stem contained in it, the outer scales are diminished in thickness, decay, and at last become perfectly dry. They appear, therefore, to supply the young

stem with a part of the materials necessary for its nutrition.

§ 4. *Of Tubercles.*

TUBERCLES (tubercula,) are true subterraneous buds, belonging to certain perennial plants. We will not here return to what we have already said, respecting the nature of tubercles. We do not think it necessary to state anew the facts and reasonings, that have induced us to regard these fleshy excrescences as true buds.

They are sometimes simple and produce but a single stem, as in the orchis; sometimes multiple, that is to say, several united together, and as it were agglomerated, each of which gives birth to a separate stem, as in the white saxifrage (saxifraga granulata.)

Sometimes compound, that is to say, having many stems issuing from a single tubercle, as in the potato.

§ 5. *Of Bulbils.*

BULBILS (bulbilli,) are a species of small solid or scaly buds, growing on different parts of the plant, and capable of an independent vegetation, that is to say, that being detached from the mother plant, they become developed, and produce a vegetable perfectly similar to that from which

they derive their origin. Plants which produce buds of this kind bear the name of viviparous (plantæ viviparæ.)

These are either produced in the axilla of the leaves, as in the bulbiferous lily (lilium bulbiferum,) in which case they are said to be axillary; or, at other times, they are developed in the place of the flowers, as in the ornithogalum viviparum, in the allium carinatum, &c.

It has been said, that bulbils are sometimes developed within the pericarp, and occupy the place of the seeds. But we have shewn (Ann. de Science Nat. 1824,) that these pretended bulbils are nothing but true seeds, which, often at the expense of the pericarp itself, have acquired an extraordinary developement. But their internal organization remains perfectly the same.

The nature of bulbils is similar to that of bulbs, properly so called. Sometimes they are scaly as in the lilium bulbiferum, sometimes solid and compact.

The small bodies which are developed in different parts of organic plants, such as ferns, club-moss, mosses, lichens, &c., and which have been very improperly called seeds, are to be considered as true bulbils. Although these bodies, which we call sporules, are capable of re-producing a plant similar to that from which they are detached, they cannot be confounded with true

seeds. In fact, the essential character of the seed is to contain an embryo, that is to say, a body of a complex nature, composed of a radicle or the rudiment of the root, of a gemmule or the germ of a stem, and of a cotyledonary body. By the act of germination, the embryo, properly so called, only developes the parts that are already contained in it perfectly formed. These parts are not produced by germination; it only places them in a condition favourable to their developement. In bulbils, on the contrary, and particularly in the sporules of agamic plants, there is no embryo. There is no trace of a radicle, of cotyledons, nor of a gemmule. These parts are created during the process of germination; they are not, therefore, true seeds.

The Uses of Buds, of Bulbs, &c.

Several buds are employed in domestic economy as articles of food; such, for example, are the turios of the asparagus and of several other plants of the same family. Every one knows the daily use which is made of the different species of the genus allium, such as the common onion (allium cepa,) garlick (allium sativum,) leek (allium porrum,) shallot (allium ascalonicum,) &c. The buds or bulbs of some vegetables are also used in medicine. Thus from the buds of the silver firr

(pinus picea,) infused in beer, is prepared a beverage which is said to have antiscorbutic virtues. The scales of the squill bulb (scilla maritima) are a powerful diuretic. It is also used for the purpose of stimulating the lungs. Garlick is known to be an useful anthelmintic, &c.

CHAPTER IV.

OF THE LEAVES.*

LEAVES, before their full developement, are always enclosed in buds. Their situation with respect to each other is various; but it is always the same in all the plants of a given species, often, of the same genus, and sometimes even, of the same natural family.

This arrangement of the leaves in the bud has received the name of prefoliation. Sometimes very excellent characters can be derived from it, for the arrangement of genera into natural families.

The principal modifications of the leaves thus arranged are the following:

1°. They may be folded longitudinally, one

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* Folia Latin, φυλλα Greek.

half on the other, that is to say, that their left lateral part is applied to their right, in such a manner, as that both their edges shall perfectly coincide with each other, as in the common syringa (philadelphus coronaria.)

2°. The leaf may be folded on itself repeatedly from above downwards, as in the monkshood (aconitum napellus.)

3°. It may be folded longitudinally so as to imitate a fan, like that of the gooseberry, of the vine, &c.

4°. It may be rolled on itself in a spiral manner, as in certain figs, in the apricot, &c.

5°. The edges of the leaf may be rolled outwards or downwards, as in the rosemary.

6°. Or they may be rolled inwards or upwards, as in the poplar, in the pear, &c.

7°. Lastly, leaves may be rolled like a crosier or the volute in architecture, as is the case, for example, in all the plants of the family of the ferns.

Let us now study the leaves after their developement.

Leaves are usually membranous, flat, greenish, horizontal organs, growing on the stem or branches, or springing immediately from the neck of the root. By the numerous pores on their surfaces, leaves serve for the purpose of exhaling and absorbing the gases, which are either become useless, or which are adapted for the nutrition of

the vegetable. The leaves seem to be formed by the expansion of a bundle of fibres proceeding from the stem. These fibres, which are vessels, by ramifying in various directions, form a kind of net work, which represents the skeleton of the leaf, and whose meshes are filled up with cellular tissue, which is more or less abundant, and which derives its origin from the herbaceous integument of the stem. When the bundle of fibres which by its expansion is to constitute the leaf, is divided and ramified as soon as it separates from the stem, the leaf is attached without any intervening organ, and is said to be sessile (folium sessile,) as in the poppy. If, on the contrary, this bundle is prolonged before it spreads out into a membrane, it then forms a species of support, which is called the leaf stalk, and to which botanists have given the name of petiole (petiolus.) In this case the leaf is said to be petiolated (folium petiolatum,) for example, in the lime tree, the tulip tree, the horse chesnut, &c. This being the most usual condition of the leaf, we may consider it as formed of two parts; namely, the petiole and the disc, that is to say, the part which being usually flat and green, constitutes what is properly called the leaf.

In the same manner, as the petiole is wanting in a great number of leaves, so does the disc also prove abortive, and the leaf, in that case, consists

only of the petiole, which is often expanded, and assumes the form and the characters of a sessile leaf. This may be observed, for example, in all the new Holland species of acacias with simple leaves. It is even probable, that in the different species of bupleurum, the leaves are only petioles. These have received the name of phyllodium.

In the leaf are distinguished an upper surface, which is usually smooth, of a green colour, covered with a closely adhering epidermis, and having but few cortical pores ; and an under surface, which is of a lighter colour, is often covered with hair or down, and whose epidermis is more loosely connected with the herbaceous integument. This surface has a greater number of small pores, which are the orifices of the internal vessels of the vegetable. Accordingly, it is particularly by their under surface, that leaves absorb the fluids that are exhaled from the surface of the earth, and that are diffused through the atmosphere. In the leaf are also distinguished its base, or the part by which it is attached to the stem, its top or the point opposite to the base, and its circumference, or the line that bounds its surface externally.

The under surface of the leaf is also remarkable for a great number of projecting lines running in various directions, which are nothing but the divisions of the petiole, and which are called

nerves (nervi.) Among the nerves there is one which has almost a constant direction. It is a continuation of the petiole, has usually a longitudinal direction, and divides the leaf into two lateral portions, which are often equal. This has received the name of midrib. From the base and sides of the midrib, the other nerves proceed in different directions, and anastomose with each other frequently. According to their thickness, and to their projection on the under surface of the leaf, the nerves are distinguished by different names. They retain the name of nerves, properly so called, when they are very prominent; they are called veins (venæ) when less so; and lastly, the ultimate ramifications of the veins, which anastomose frequently, and strictly speaking, constitute the skeleton of the leaf, are called venules (venulæ.)

The nerves, notwithstanding the resemblance of their name, have no similarity of structure or of function to the nerves of animals. They are bundles of porous vessels, of spirals, and of false spirals, enveloped in a certain quantity of cellular tissue.

The nerves are sometimes prolonged beyond the circumference of the disc, and then, when they have a certain degree of rigidity, they form more or less pointed spines, as may be seen, for example, in the holly (ilex aquifolium.)

The disposition of nerves in the leaves deserves the greatest attention. In fact, it may serve to characterize certain divisions of vegetables. Thus, for instance, in most of the monocotyledons, the nerves are almost always simple, but little ramified, and often parallel to each other.* The most remarkable varieties in the disposition of nerves may be referred to the following:

1°. All the nerves may proceed from the base of the leaf, and be directed towards its summit, without undergoing any sensible division : for example, in a great many of the monycotyledonous plants.

Leaves which have this disposition of the nerves are called basinerved, or digitinerved (folia basinervia, digitinervia.)

2°. When, on the contrary, the nerves spring from the sides of the midrib, and are directed either horizontally, as in the plantain tree (musa paradisiaca,) or obliquely towards its summit, as in the amomum zerumbet, the leaves take the name of laterinerved or penninerved, (folia laterinervia, penninervia.)

3°. Lastly, if the nerves arise at once both from the base of the leaf and from the sides of the

* The aroideæ, and some of the asparagineæ, are the only exception to this general rule.

midrib, the leaves are then said to be mixtinerved (folia mixtinervia,) as may be observed in many of the buckthorns.

All the other dispositions that the nerves of leaves are susceptible of, may be referred to one of the three principal types that we have now established, or are only slight modifications of them.

A leaf, whether sessile or petioled, may be connected in different ways with the stem or branch that supports it. Sometimes it is simply jointed on them, that is to say, it is not immediately connected with them by its entire base, but is simply attached to them by a kind of contraction or articulation, as in the plane tree, in the horse chesnut. In this case the leaves are *caducous*, and fall very early.

At other times, the leaves are so connected with the stem, that they cannot be separated without tearing. In this case, the leaves continue on the tree, as long as the branch that supports them; as in the ivy, &c.

The manner in which sessile leaves are attached to the stem, is equally deserving of attention.

Thus the midrib sometimes expands and embraces the stem, in nearly the one half of its circumference. The leaves are then said to be semi-amplexicaul (folia semi-amplexicaulia.)

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On the contrary, the leaf is said to be amplexicaul (amplexicaule,) when it embraces the stem in the whole of its circumference; for example, in the yellow goat's beard (tragopogon pratense,) in the white poppy (papaver somniferum.)

Often too, the base of the leaf is prolonged by forming a sheath which embraces the entire stem, and encloses it to a certain distance. In this case, the leaves are called sheathing (folia vaginantia,) as in the grasses, the cyperaceæ, &c. This sheath may be regarded as a very wide petiole, whose two edges are sometimes united so as to form a kind of tube. The point of union of the disc with the sheath, has received the name of collar. Sometimes it is naked, sometimes hairy as in the poa pilosa, or it is furnished with a membraneous appendage called ligula or collar. This may be observed particularly in the gramineæ. The form of the ligula is very various in the different species, and very often it is employed as a good specific character.

The sheath is usually entire; but sometimes it is slit longitudinally. With a very few exceptions, this character distinguishes the family of the gramineæ from that of the cyperaceæ; the former having the sheath generally slit, while it is entire in the cyperaceæ.

Sometimes the disc of the leaf, instead of ter-

minating at its point of origin on the stem, is more or less continued downwards on that organ, so as to form a species of membranous wings. In this case the leaves are said to be decurrent (folia decurrentia,) and the stem is called winged (caulis alatus,) as in the great mullein (verbascum thapsus,) the common comfrey (syphytum officinale,) &c.

A perfoliate leaf (folium perfoliatum,) is that whose disc seems to be perforated by the stem, as in the bupleurum rotundifolium, &c. (See Pl. 3. fig. ii.)

The name of connate leaves (folia connata,) is given to those opposite leaves, which are so connected at the base, that the stem passes between their united discs. Such are the upper leaves of the honeysuckle (lonicera caprifolium,) those of the teasel (dipsacus fullonum,) of the soapwort. (See Pl. 3. fig. 10.)

A simple leaf (folium simplex,) is that whose petiole has no sensible division, and whose disc is formed of a single piece; for example, the lilach, the lime tree, the elm, &c. (See all the figures of Pl. 3.)

A compound leaf (folium compositum,) on the contrary, results from the union of a more or less considerable number of small leaves, which are isolated and distinct from each other, and are called leaflets (foliola.) They are attached either

to the sides or at the top of a common petiole, which, in the former case, is called a rachis. Each leaflet may be either sessile on the rachis, that is to say, attached only by the base of its midrib, or it may be borne on a small proper petiole, which takes the name of petiolulus. Such are the leaves of the acacia, of the horse chesnut, &c. (See all the figures of Pl. 4.)

Compound leaves are distinguished into the jointed and not jointed. The former are those whose leaflets are attached to the common petiole by a species of joint, which is capable of motion, as may be observed in the acacia, in the cassias, and in general, in most plants of the family of the leguminosæ. These are the only plants that exhibit the phenomenon which Linnæus calls the sleep of leaves; for it never appears in those which are not jointed on the petiole.

Between the simple leaf and the compound leaf there is a series of modifications, which serves to shew the insensible transition from the one to the other. Thus, there are first the toothed leaves; others which are divided to half their depth into distinct lobes; others whose divisions reach nearly to the midrib, and thus resemble a compound leaf. But it will be always easy to distinguish them from the truly compound leaf, by observing that in the latter, each of the pieces that compose it may be detached, without, in any

degree, injuring the others, whereas in the simple leaf, however deeply it may be divided, the foliaceous part or disc of each division is continuous at its base with those adjoining, so that one of them cannot be separated without tearing the other two between which it is situated.*

All the leaves of a plant do not invariably possess the same form. In some vegetables, there is, in this respect, even a very marked difference. Thus, every one must have observed, that the ivy has some leaves entire, and others which are deeply lobed. In general, the plants which have leaves proceeding immediately from the root, and others growing from different points of the stem, seldom have them perfectly similar. The garden valerian has the radical leaves divided on their sides, while the leaves on the stem are entire.

Leaves also vary according to the medium in which they grow. Aquatic plants have usually two species of leaves; the one floating on the surface of the water, or raised a little above its level, the others, on the contrary, always immersed in that fluid. Thus, for instance, the water crowfoot (ranunculus aquatilis) has lobed leaves that float, and leaves divided into very narrow and

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* The divisions of the compound leaf are attached to the common petiole by their midrib only; those of the simple leaf are also attached by a portion of the leafy expansion.

numerous segments that are immersed in the water. There is a great number of other plants that resemble it in this respect.

We are now about to consider the numerous modifications of form, direction, nature, &c. which may belong to the simple leaf and to the compound leaf.

§ 1. *Of the Simple Leaf.*

A. With respect to the part of the plant on which they grow, leaves are:

1°. Seminal (seminalia,) when they are formed by the developement of the cotyledonary body. It is obvious that their number will be either one or two; but seldom more. (See Pl. 7. fig. B. b. b.) 13

2°. Primordial (folia primordialia.) These are the first that appear after the seminal leaves. They are formed by the two external leaflets of the gemmule. (See Pl. 7. fig. 12. dd.)

3°. Radical leaves (folia radicalia,) are those which grow immediately from the collar of the root, as in the plantain (plantago major,) dandelion (leontodon taraxacum,) &c.

Cauline leaves (folia caulinaria,) are those which are attached to the stem.

Rameal (folia ramealia, ramea,) when they grow on the branches.

Floral (fol. floralia,) those which accompany

the flowers, and are situated at their base, without changing either their form or their structure; as in the honeysuckle.

B. According to their arrangement on the stem or branches, they are, opposite (fol. opposita,) placed two together at the same height, on two points of the stem which are diametrically opposite; as in the sage (salvia officinalis,) and all the labiate plants, the speedwell (veronica officinalis,) &c.

Leaves are said to decussate (f. cruciatim opposita, seu decussata,) when the pairs of leaves placed above each other cross one another at right angles, as in the spurge (euphorbia lathyris.)

Alternate (fol. alterna,) growing singly, at nearly equal distances on different points of the stem; as in the lime tree (tilia europæa.)

Scattered (fol. sparsa,) when they follow no particular order, and are dispersed irregularly over the stem, as in the common toad flax (linaria vulgaris,) &c.

Verticillate or whorled (fol. verticillata,) when they grow more than two together, at the same height around the stem or on the branches, as in the rose bay (nerium oleander,) the madder (rubia tinctorum,) &c.

According to the number of leaves that forms each whorl, they are said to be:

Ternate (fol. terna,) when the whorl is com-

posed of three leaves, as in the three leaved vervain (verbena triphylla,) rose bay, &c.

Quaternate (folia quaterna,) when the whorl is composed of four leaves, for example, in the crosswort (valantia cruciata.)

Quinate (fol. quina,) a whorl of five leaves: several species of ladies' bedstraw, myriophyllum verticillatum.

Senate (fol. sena,) a whorl of six leaves, as in galium uliginosum.

Octonate (fol. octona,) a whorl of eight leaves; for example, that of the sweet scented woodruf (asperula odorata.)

Twin (fol. gemina,) growing in pairs beside each other, from the same point of the stem. The upper leaves of the deadly nightshade (atropa belladoma,) of the winter cherry (physalis alkekengi.)

Two ranked (fol. disticha,) placed in two rows opposite to each other, as in the elm (ulmus campestris,) in the common laurel (prunus laurocerasus.)

Unilateral (fol. unilateralia,) when they are all turned to the same side; for example, the convallaria multiflora, &c.

Distant (folia remota,) when they are very romote from each other.

Crowded (conferta, approximata,) growing at very short distances from each other.

These two terms are never used in a positive sense; they are always employed to express a comparison with other known species.

Imbricated (imbricata,) when they partially cover one another like the tiles of a house; as in certain species of aloe, thuya, &c. Imbricated leaves are said to be biseriated, when they are placed in two longitudinal rows.

Triseriated and quadriseriated, when placed in three or four longitudinal rows, of the latter of which we have an example in thuya.

Lastly, they are said to be imbricated on all sides, when they have no regular order.

Fasciculated (fol. fasciculata,) growing more than two together from the same point of the stem, as in the cherry (cerasus communis,) the larch (pinus larix,) the barberry (berberis vulgaris,) &c.

Crowning (folia coronantia, terminantia,) collected in a cluster at the top of the stem, as in the palms, in the papaw tree (carica papaya.)

Rosulated, or like a rose (folia rosulata,) alternate and close together like the petals of a rose, as in the house leek (sempervivum tectorum,) the dandelion, &c.

C. In regard to their direction with respect to the stem, leaves are:

Erect (erecta,) when they form a very acute

angle with the upper part of the stem, as in the great reed mace (typha latifolia.)

Adpressed (fol adpressa,) when the disc of the leaf is applied to the stem.

Open or spreading (patentia,) when they form nearly a right angle with the stems, as in the ground ivy (glechoma hederacea,) tutsan (hypericum androsœmum,) &c.

Inflexed (folia inflexa,) when they are bent inwards like those of many of the malvaceæ.

Involute (f. involuta,) when they are rolled inwards like those of the ferns.

Reflexed (f. reflexa,) those which are bent suddenly outwards, as in the inula pulicaria, dracæna reflexa, &c.

Revolute (f. revoluta) rolled outwards.

Pendant (f. pendentia,) those which hang nearly perpendicularly towards the earth, as in the great bindweed (convolulus sepium,) the spurge laurel (daphne laureola.)

Inverted (inversa,) when the petiole is twisted in such a manner as that the under becomes the upper surface, as in the pharos.

Humifuse (fol. humifusa,) when they are radical, soft, and spreading on the ground, as in the daisy, (bellis perennis.)

Floating (natantia,) resting on the surface of the water, as in the white water lily, (nymphæa alba.)

Submersed (fol. submersa, demersa,) concealed under the water : those of the hottonia palustris.

Emersed (f. emersa,) when their point of attachment is under the water, and their petiole raises them above the surface of that fluid, like those of the water plantain (alisma plantago,) of the arrow head (sagittaria sagittæfolia.)

D. Circumscription or figure.

Orbicular (f. orbiculata,) those whose circumference approaches to the figure of a circle, as that of pennywort (hydrocotyle vulgaris.) (See Pl. 3. fig. 9.)

Oval (f. ovalia,) oblong, rounded at both extremities, the lower extremity being the broadest: examples, elecampane (inula helenium,) common chick weed (stellaria media,) the great periwinkle (vinca major.) (See Pl. 3. fig. 1.)

Oboval (obovalia,) the former reversed, that is to say, with the larger extremity turned upwards, as in the trailing arbutus (arbutus uva ursi,) in the common brook weed (samolus valerandi,) &c.

Elliptical (f. elliptica,) oblong, with both the ends rounded and equal to each other, as in the lily of the valley (convallaria majalis.) (See Pl. 3. fig. 2.)

Oblong (oblonga,) elliptical, very long, and narrow.

Lanceolate (f. lanceolata,) oblong, and terminating gradually in a point towards the summit :

plantago lanceolata, rose bay (nerium oleander,) the peach tree (amygdalus persica.)

Linear (f. linearia,) lanceolate, but narrow: most of the grasses.

Riband shaped (f. fasciaria, graminea,) a little broader than the former, but much longer: valisneria spiralis, typha latifolia.

Awl shaped (subulata,) very narrow at the base, and contracted insensibly to a sharp point at the summit: the common juniper (juniperus communis.)

Acicular and setaceous (f. acicularia, setacea,) long, stiff, and sharp pointed, having some resemblance to needles or to swine's bristles, for example, those of asparagus acutifolius, &c.

Capillary (fol. capillaria,) fine and flexible like hair; those of common asparagus (asparagus officinalis.)

Filiform (f. filiformia,) small, slender, and very fine like a thread: example, the water crow foot (ranunculus aquatilis.)

Spatulata, having the shape of a spatula (f. spatulata,) small and narrow at the base, broad and rounded at the top: the daisy (bellis perennis.) (See Pl. 3. fig. 3.)

Wedge shaped having the figure of a wedge (f. cuneata,) very narrow at the base, growing broader at the top, which is truncated. Example, saxifraga tridentata, &c. (See Pl. 3. fig. 12.)

Parabolic (f. parabolica,) oblong, rounded above, and truncated below.

Falciform (f. falcata,) bupleurum falcatum, &c.

Inequilateral (f. inequilatera,) when the midrib divides the leaf into two unequal portions, for example, in the lime tree, in the begonia obliqua, &c.

E. The leaves may be variously notched at their base, which produces a considerable variety of figures. Thus they are said to be cordate, or heart shaped, or cordiform (fol. cordata, cordiformia,) when they are notched at their base in such a manner as to have two rounded lobes, and terminate at the top by growing gradually narrower, as in the tamus communis, the white water lily (nymphæa alba,) &c. (See Pl. 3. fig. 4, 5.)

Cordiform leaves may be at the same time oblique or inequilateral (oblique cordata,) as in the lime tree, &c.

Reniform leaves, or kidney shaped (f. reniformia,) when they are much broader than they are long, and are rounded at the top, with a cordiform notch at the base: common asarabacca (asarum europæum,) ground ivy (glechoma hederacea.) (See Pl. 3. fig. 6.)

Crescentic (f. lunulata,) rounded and divided at their base into two narrow lobes.

Sagittate (f. sagittate,) when they are acute, and their base is prolonged into two pointed lobes,

which are slightly divergent. Example, the arrow head (sagittaria sagittæfolia.) (See Pl. 3. fig. 7.)

Hastata (fol. hastata,) the base prolonged into two acute lobes, very distant, and turned outwards, as in the arum maculatum. (See Pl. 3. fig. 8.)

F. The leaves may be terminated in various ways at their summit. Hence they take the names of:

Acute (f. acuta,) when they gradually narrow into a point at their summit, like those of the rosebay. (See Pl. 3. fig. 4, 7.)

Sharp pointed (fol. pungentia,) ending in a stiff point, as in the furze (ulex europæus,) butcher's broom (ruscus aculeatus.)

Acuminated (f. acuminata,) when the edges change their direction near their summit, and are prolonged as they approach, as in the hazel (corylus avellana,) the cornel (cornus mascula.)

Mucronated (f. mucronata,) surrounded with a small, slender, isolated point, which appears not to be continuous with the top of the leaf, as in the house leek (sempervivum tectorum.)

Uncinated (f. uncinata,) terminating in a point which forms a hook.

Obtuse (fol. obtusa,) a general term used in opposition to that of acute: nymphæa alba, &c. (See Pl. 3. fig. 1, 2, 5.)

Emarginate (f. emarginata,) having a small

notch at the summit, like those of a crenate leaf, as in the box tree (buxus sempervirens,) asarabacca (asarum europæum,) &c. (See Pl. 3. fig. 6.)

Retuse (f. retusa,) having a slight sinus or depression at the top, as in the cow berry (vaccinium vitis idæa.)

Obcordate (f. obcordata,) that is the cordate reversed, as in the leaflets of the wood sorrel (oxalis acetosella.)

Bifid (f. apice bifida,) divided at the top into two sharp pointed segments of little depth.

Two-lobed (f. apice biloba,) when the divisions are separated by an obtuse sinus.

Bipartite (f. apice bipartita,) when the two divisions are very deep and sharp-pointed.

G. Leaves may have in their circumference a more or less considerable number of angles, which shall be more or less marked. To express these characters, they have the following name:

Rhomboidal (f. rhomboidea,) when they have four angles, of which two opposite ones are more acute; example, campanula rhomboidalis, &c.

Deltoidea (f. deltoid,) when they have the figure of a rhomboid whose lower angle is very short, so as to make them appear triangular, or approaching the form of the Greek delta Δ: example, mesembry-anthemum deltoides.

Trapezoid (f. trapezoidea,) having the figure of a trapezium, that is to say, of a quadrilateral

whose sides are unequal: example, several of the ferns.

Triangular (triangulata,) having three angles.

Quadrangular (f. quadrangulata.)

H. Simple leaves, as has been already remarked, may be divided to a very considerable depth, without yet being regarded as compound. Thus they may be:

Trifid (f. trifida.)

Quadrifid (f. quadrifida.)

Quinquefid (f. quinquefida.)

Sexfid (f. sexfida.)

Multifid (f. multifida,) when they have three, four, five, six, or a greater number of narrow divisions of little depth:

Three lobed (f. triloba.)

Four lobed (f. quadriloba.)

Five lobed (f. quinqueloba.)

Many lobed (f. multiloba,) when the divisions are broader, and separated by an obtuse sinus.

Tripartite (f. tripartita.) (See Pl. 3. fig. 15.)

Quadripartite (f. quadripartita,) quinquepartitæ (f. quinquepartita.) (See Pl. 3. fig. 18.)

Multipartite (f. multipartita,) if the divisions are so deep as to pass through two-thirds at least of the disc of the leaf.

Laciniated (f. laciniata,) those whose divisions are deep and very unequal, as in many of the syngenesious plants. (See Pl. 3. fig. 17.)

Palmated (f. palmata,) when all the nerves, proceeding in a radiating manner from the top of the petiole, are directed respectively to the middle of each division, as in the rhubarb (rheum palmatum.) (See Pl. 3. fig. 16.)

Auriculated (f. auriculata,) having two small appendages at the base, which are called auricles, as in the sage (salvia officinalis,) the water figwort (scrophularia aquatica,) &c.

Panduriform (f. panduriformia, pandurata,) approaching to the figure of a violin, that is to say, oblong, rounded at both extremities, and having a sinus at each side, as in the convolvulus panduratus, the rumex pulcher, &c.

Sinuated (f. sinuata,) having one or more rounded notches, of a determinate number.

Sinuose (f. sinuosa,) having rounded depressions, with lobes which are also rounded and convex, of an indefinite number, as in the oak (quercus robur.)

Pinnatifid (f. pinnatifida,) divided laterally into lobes of a variable depth, as in the polypodium vulgare, the coronopus ruelli.

Interruptedly pinnatifid, (f. interruptè pinnatifida,) are those whose upper divisions are confluent at the base, while the lower are wholly free, so that these leaves represent in their upper part a pinnatifid leaf, and in their lower part a pin-

nate leaf. But yet they cannot be confounded with leaves which are truly compound.

Pectinated (f. pectinata,) resembling a comb. Pinnatifid leaves, whose divisions are narrow, close, and almost parallel, as in the achillæa pectinata.

Lyrate (f. lyrata,) pinnatifid leaves terminating in a rounded lobe much larger than the others, as in the common avens (geum urbanum,) the wild radish (raphanus raphanistrum,) &c. (See Pl. 3. fig. 14.)

Runcinate (f. runcinata,) pinnatifid leaves whose lateral lobes are acute and curved downwards; for example, the dandelion, the wall lettuce (prenanthes muralis,) &c. (See Pl. 3. fig. 13.)

I. With respect to their circumference, or to the modifications of their border, leaves are:

Entire (integra,) when their border runs round, without either tooth, or incision, or sinus, as in the great periwinkle (vinca major,) the lilach, &c. (See Pl. 3. fig. 2, 3, 4, 5.)

Eroded (f. erosa,) having small unequal teeth, so as that the border of the leaf appears to be gnawed by an insect, as that of the sinapis alba, &c.

Crenate (f. crenata,) whose border has crenatures or small rounded projections, separated by incisions, as in the ground ivy (glechoma hede-

racea,) the white horehound (marrubium vulgare,) betony (betonica officinalis.)

Doubly crenate (f. duplicato crenata,) when each principal crenature has others smaller, as in chrysosplenium alternifolium and hydrocotyle vulgaris. (See Pl. 3. fig. 9.)

Toothed (fol. dentata,) whose border is cut into small sharp teeth, neither inclining to the base nor to the summit of the leaf, as in sauce alone (erysimum alliaria,) groundsel (senecio vulgaris.)

Serrated or toothed like a saw (folia serrata,) when the teeth are inclined to the summit of the leaf, as in the violet (viola odorata,) the wayfaring tree (viburnum lantana,) &c. (See Pl. 3. fig. 1.)

Doubly serrated (f. duplicato-serrata,) when each tooth is itself serrated, as in the hazel (corylus avellana,) the elm (ulmus campestris.)

Spinous (f. margine spinosa,) having the edge armed with stiff, sharp pointed teeth, as in the holly (ilex aquifolium,) many of the thistles.

Ciliated (fol. ciliata,) having the border furnished with hairs arranged like the lashes of the eyelid; for example, in the erica tetralix, the luzula vernalis, &c.

K. Expansion.

The leaves may be:

Plane (f. plana,) when their surface is neither

convex nor concave, as is the case with the leaves of most plants.

Convex (f. convexa,) when they are swollen on their upper surface.

Concave (f. concava,) swollen on their under surface, so as to have a cavity on their upper.

Ensiform (f. ensiformia,) greatly compressed on the sides, so as to have their surfaces lateral, and their edges posterior and anterior, as in the iris germanica.

Striated (f. striata,) having striæ in different directions.

Undulated (f. undulata,) having irregular elevations and depressions, which are compared to the waves of agitated water. The waved leaved rhubarb (rheum undulatum.)

L. The surface.

Shining (f. lucida,) having a smooth surface that reflects the light: the rose bay, the ivy.

Smooth (f. lævia,) having no prominence, or roughness of any kind: the nymphæa, &c.

Glabrous (f. glabra,) free from every species of hairs: the lesser centaury (erythræa centaurium,) the rose bay.

Perforated (f. pertusa,) pierced with very sensible holes: dracontium pertusum.

Cancellated (f. cancellata,) when the cellular tissue does not exist, and they are composed exclusively of ramifications of nerves frequently

anastomosing, and resembling a kind of net work, as in the hydrogeton fenestralis.

Glandular (f. glandulosa,) having small glands on their surface.

Scabrous (f. scabra,) rough to the touch. The elm (ulmus campestris,) common gromwell (lithospermum officinale.)

Glutinous (f. glutinosa,) being more or less viscid to the touch. Inula viscosa.

M. Pubescence (see what has been already said of it in speaking of the stem.)

N. Consistence and texture.

Membranous (f. membranacea,) having no sensible thickness, soft and pliant, like those of the broad leaved birth wort (aristolochia sypho.)

Scarious (f. scariosa,) thin, dry, and semi-transparent.

Coriaceous (f. coriacea,) when they are thick and have a certain consistence: those of the misseltoe (viscum album,) of the common laurel, &c.

Soft (f. mollia,) having little solidity, and being soft to the touch: spinage (spinacia oleracea,) marshmallow (althæa officinalis.)

Rigid (f. rigida,) coriaceous and not easily bent; as butcher's broom (ruscus aculeatus.)

Fleshy (f. carnosa,) the house leek, and, in general, all succulent plants.

Hollow (f. fistulosa,) the common onion (allium cepa.)

O. Form.*

Ovate (f. ovate,) having the form of an egg.

Obovate (f. obovata,) having the form of an egg reversed.

Conoïdal (f. conoïdea,) having the form of a cone.

Cylindrical (f. cylindrica, teretia,) having the form of an oblong cylinder: the sedum album, the common onion.

Tongue shaped (f. linguiformia,) having the thickness and form of a tongue; the house leek (sempervivum tectorum.)

Triquetrous (f. triquetra,) elongated into a triangular prism: the flowering rush (butomus umbellatus.)

Tetragonal (f. tetragona,) having the shape of a four-sided prism: gladiolus tristis.

Compressed (f. compressa,) thick, fleshy, and flattened laterally, being more thick than wide.

P. Colour.

Green (f. viridia,) most leaves.

Coloured (f. colorata,) of any other colour than green.

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* Form is distinct from figure, inasmuch as it belongs only to solids. Figure, on the contrary, belongs to surfaces. It is therefore, necessary, that their various modifications should be expressed by distinct terms. Thus, an egg is ovate; but a flat leaf representing a longitudinal section of it, is, properly speaking, oval.

Glaucous (f. glauca,) magnolia glauca, cabbage (brassica oleracea.) Those which have a sea green colour. This arises from a thin layer of resinous matter, similar to that which covers certain fruits, and in particular, plumbs and raisins. It is remarkable, that glaucous leaves, when moistened, are not subject to mouldiness, a fact which demonstrates the nature of the coating which gives them the glaucous colour.

Of different colours (f. discolora,) when the two surfaces are not of the same colour. Thus, in the ivy leaved toad flax (antirhinum cymbalaria,) and cyclamen europæum, the under surface is purple and the upper surface green.

Spotted (f. maculata,) having spots of a different colour from that of the leaf: arum maculatum.

Hoary (f. incana,) of a pure white. Achillæa incana.

Q. Petiolation.

Sessile (f. sessilia,) the common box (buxus sempervirens,) &c.

Petiolated (f. petiolata,) the plane tree, the pear, the apricot.

Peltate (f. peltata,) when the petiole is inserted in the middle of the under surface of leaves, and its nerves proceed in a radiating manner, from this point to the circumference. As in the nasturtium (tropæolum majus,) in the

pennywort (hydro cotyle vulgaris.) (See Pl. 3. fig. 9.)

When leaves have a petiole, it is not right to neglect the characters which may be derived from its different modifications.

Thus, it may be cylindrical, compressed, triquetrous, filiform, short, long, &c. The meaning of most of these terms has been already explained in other places.

The petiole may be twisted on itself, as in many of the cucurbitaceæ, &c.

Club shaped (claviformis,) when it is swelled considerably at its upper part, as in the water caltraps (trapa natans.)

Channelled or grooved (canaliculatus,) when it is convex on its outer surface, concave near the stem, as in many of the umbelliferæ.

Winged (alatus,) when the disc of the leaf is continued along the sides of the petiole, so as to form a membraneous appendage, as in the orange (citrus aurantium.)

In compound leaves, the common petiole is sometimes composed of as many jointed membraneous pieces, as there are pairs of leaflets; this may be observed in the quassia amara, and several species of inga.

Leaf like (foliiformis,) when it is broad and thin with the aspect of a leaf. In this case it very often replaces the true leaves, which exist only in the young plant, and fall at a certain

period. Thus, the pretended simple leaves of the mimosæ of New Holland are only expanded petioles, resembling a leaf. They have received the name of *phyllodium.*

The petiole is sometimes accompanied with a membranous sheath, which has received the name of ochrea, and embraces the stem in its whole circumference. The presence of this organ is one of the best characters for distinguishing the plants belonging to the family of the polygoneæ, which are all possessed of it.

R. According to their duration on the stem, leaves are distinguished into:

The caducous (f. caduca,) when they fall shortly after their appearance, as those of many species of cactus.

Deciduous (f. decidua,) when they fall before the appearance of the new leaf; as those of the horse chesnut, of the lime tree, &c.

Marcescent (f. marcescentia,) when they wither on the plant before falling, like those of the oak.

Persistent (f. persistentia,) those which remain on the vegetable more than one year; for example, in the pines, the box, the common laurel, &c. These trees bear the general name of evergreens.

§ 2. *Of Compound Leaves.*

The truly compound leaf, as was formerly observed, is that which, on a common petiole, bears

several leaflets, which can be separated from each other. These leaflets are either jointed on the rachis, that is to say, attached to it by a very contracted portion of the base of their little petiole, or continous with it by the whole of that base.

There are different degrees of composition in leaves. Thus the common petiole may be either simple, or it may be ramified.

When the common petiole is not ramified, the leaf is said to be simply compound. It is called a decompound leaf, when the petiole is ramified.

We shall now examine the different modifications of each.

The simply compound leaves have two principal modifications, depending on the position of the leaflets that compose them. Thus, sometimes all the leaflets proceed from the very top of the common petiole, as in the horse chesnut, trefoil, &c.; sometimes, on the contrary, they spring from the sides of the common petiole, as in the ash, the bladder senna, the acacia, &c. The name of *digitate* leaves has been given to the former of those modifications, and that of *pinnate* leaves to the latter.

Digitate leaves (f. digitata,) are, therefore, those of which all the leaflets proceed in a divergent manner from the top of the common petiole, like the fingers of the hand when it spreads out.

The number of leaflets in the digitate leaf is very various, as may be seen by comparing the leaves of the trefoil, which have only three, with those of the pavia, which have five, of the horse chesnut which have seven, and of the lupin, which have a great number.

According to the number of leaflets the digitate leaves are divided into:

The unifoliolate (f. unifoliolata,) when they have but one leaflet, which, however, is jointed at the top of the petiole. In this case, the presence of a joint, and reasons drawn from analogy, cause this leaf to be regarded as one of the compound. Such are those of the orange (citrus aurantium,) of the rosa simplicifolia, &c. (See Pl. 4. fig. 1.)

Trifoliolate (f. trifoliolata,) when they have three leaflets, as in the buck bean (menyanthes trifoliata,) the wood sorrel (oxalis acetosella.) (See Pl. 4. fig. 5.)

Quadrifoliolate (f. quadrifoliolata,) composed of four leaflets: marsilea quadrifolia.

Quinquefoliolate (f. quinquefoliolata,) cissus quinquefolia, potentilla reptans, &c.

Septemfoliolate (f. septemfoliolata,) the horse chesnut, &c. (See Pl. 4. fig. 6.)

Multifoliolate (f. multifoliolata,) composed of a great number of leaflets, as the lupinus varius.

Pinnate leaves (f. pinnata,) as has been already mentioned, are those which bear a more or less

considerable number of leaflets on a common petiole, arranged along its sides like the barb of a feather; such are those of the acacia, the ash, &c. (See Pl. 4. fig. 3.)

The leaflets of a pinnate leaf may be opposite to each other, and disposed in pairs, in which case they are said to be oppositely pinnate, or else the leaflets are alternate, and the leaves are said to be alternately pinnate. Oppositely pinnate leaves are also called conjugate. They are said to be:

Unijugate (f. unijugata,) when they consist of a single pair of leaflets, as in lathyrus latifolius, lathyrus sylvestris, &c. (See Pl. 4. fig. 4.)

Bijugate (f. bijugata,) composed of two pairs of leaflets, as in certain species of mimosa. (See Pl. 4. fig. 2.)

Trijugate (f. trijugata,) composed of three pairs of leaflets, like those of the orobus tuberosus.

Quadrijugate (f. quadrijugata.)

Quenquejugate (f. quinquejugata,) like those of the cassia fistula.

Multijugate (f. multijugata,) when the pairs of leaflets are of an indefinite number, like those of the liquorice milk vetch (astragalus glycophyllus,) the vicia craca, &c.

Oppositely pinnate leaves are said to be paripinnate, or pinnate without an odd leaflet, when

the leaflets are attached by pairs, and the top of the petiole has no solitary leaflet, nor tendril instead of it, as in

(Ceratonia siliqua,) orobus tuberosus, &c. (See Pl. 4. fig. 2.)

On the contrary, they are said to be imparipinnate or pinnate with an odd leaflet (imparipinnata,) when the common petiole is terminated by a solitary leaflet, as in the acacia (robinia pseudoacacia,) the ash (fraxinus excelsior.) (See Pl. 4. fig. 3.)

Imparipinnate leaves are said to be trifoliolate (f. imparipinnata trifoliolata,) when, besides the single pair of leaflets that composes them, they have a solitary petioled leaflet, as in the different species of dolichos, of glycine, of phaseolus, &c.

Interruptedly pinnate leaves (f. interrupte-pinnata,) are those whose leaflets are alternately large and small, as in the agrimony.

With respect to decursively pinnate leaves, that is to say, those whose common petiole is winged by the prolongation of the base of the leaflets, they are not to be regarded as compound, inasmuch as none of the leaflets can be removed without tearing the leafy expansion. They are only more or less deeply pinnatifid leaves.

Doubly compound leaves (f. decomposita,) are the second degree of composition of leaves; the common petiole being divided into secondary pe-

tioles which bear the leaflets. They are called digiti-pinnate (f. digitato-pinnata,) when the secondary petioles represent pinnate leaves proceeding from the top of the common petiole. Example, certain species of mimosa.

Bigeminate (f. decomposito-bigeminata,) when each of the secondary petioles bears a single pair of leaflets. Example, mimosa unguiscati.

Bipinnate (f. bipinnata, duplicato-pinnata,) when the secondary petioles are so many pinnate leaves arising from the common petiole, as in the mimosa julibrizin, &c. (See Pl. 4. fig. 7.)

The third and last degree of composition exhibited by leaves is the supra decompound. In this case, the secondary petioles are divided into tertiary petioles bearing leaflets. Thus, the leaf is called supra decomposito triternatum, whose common petiole is divided into three secondary petioles, which are again divided into three tertiary petioles, each bearing three leaflets, as in the actæa spicata, epimedium alpinum. (See Pl. 4. fig. 8.)

We have explained, with some minuteness, the numerous varieties of form, figure, consistence, simplicity and composition which are observed in leaves. We have thought it useful to go a good deal into detail in treating this article, because many organs which we shall hereafter have occa-

sion to study, such as stipules, sepals, petals, &c. will exhibit similar modifications of figure, form, and structure, which once described and defined, will need only to be mentioned in order to be perfectly understood.

The Structure, Uses, and Functions of Leaves.

Leaves, as we have already explained, are composed of three principal organs, namely, of a bundle of vessels proceeding from the stem, of cellular substance, which is a prolongation of the herbaceous integument of the bark, and lastly of a portion of epidermis, which covers their entire surface.

The vascular bundle constitutes the petiole when that organ is present. It is composed of spirals, false spirals, and porous vessels. In the petiole, they are covered externally by a layer of herbaceous integument, which is prolonged over them as they issue from the stem. By their expansion and repeated ramifications, they form the network of the leaf. The meshes or empty spaces between them are filled up with cellular tissue continued from the bark. This, however, is sometimes wanting, as in the hydrogeton; and then the leaf, which consists only of the vascular network, presents the appearance of a species of lattice work or of lace.

The epidermis which covers the surfaces of the leaf is in general very porous, particularly on the under surface.

The two layers of epidermis cover the part composed of vascular fibres and of cellular tissue, for which De Candolle has proposed the name of mesophyl.

This organ is sometimes very thin, as may be observed in leaves which are flat and membranous; but in all thick and fleshy leaves, in those of succulent plants, for instance, the mesophyl is greatly developed, and gives form to the leaf.

The stomata or pores which are observed on leaves are, according to some authors, only the upper orifices of the sap vessels. Hence it follows, that they are numerous in proportion as the leaves are more fibrous. The leaves and the roots are the principal organs of absorption and nutrition in vegetables. In fact, they absorb from the atmosphere nutritive substances which are made subservient to their growth. Accordingly some authors have proposed to call them air roots. They also perform other functions of the highest importance in the vegetable economy. They serve for the purpose of expiring and of exhaling fluids which are become useless to the vegetable, and it is by their means that the sap is divested of its aqueous constituent, and acquires all its nutritious qualities.

It is chiefly by the pores on the under surfaces of the leaves of woody plants, that the aqueous vapour and gases diffused through the atmosphere are absorbed. In fact, this under surface is less smooth, softer, and is almost invariably furnished with more or less down, which favours this absorption. Their upper surface, on the contrary, being smoother and generally glabrous, serves for the excretion of fluids, which are useless to vegetable nutrition. This is what constitutes the transpiration of vegetables.

The leaves of herbaceous plants being nearer to the soil, and immersed in an atmosphere which is constantly humid, absorb equally by their upper and their under surfaces. For the knowledge of this fact we are indebted to the celebrated Bonnet. This naturalist placed the leaves of trees upon water by their under surfaces; they continued fresh and green for several months. He placed others in a similar situation by their upper surfaces, and in a few days they were completely withered. The leaves of herbaceous vegetables retained their verdure for the same length of time, when placed on the water by either of their surfaces.

The decomposition of the carbonic acid absorbed from the atmosphere is effected in the cellular substance of the leaves, as well in all the other green and herbaceous parts of the vegetable.

When exposed to the action of the sun, they decompose that gas, retain the carbon, and set free the oxygen. The contrary happens when they are withdrawn from the action of light; for, in that case, they take a portion of its oxygen from the air, and replace it with an equal quantity of carbonic acid. It is well known that vegetables which are not exposed to the sun's influence become blanched, that is to say, that they lose their colour, become soft, watery, and contain a greater proportion of saccharine principle. But we shall soon consider more particularly the phenomena of absorption and of exhalation, in treating of the nutrition of vegetables.

Leaves are susceptible of certain motions, which clearly depend on the irritability which they are endued with. Numerous and well authenticated facts place the existence of such a property in vegetables beyond any doubt.

If a branch, which remains connected with the stem, be so placed as that the under surface of its leaves shall look upwards, they will be seen to return gradually, and to resume their natural position. This fact may be daily observed in pruning and palisading espaliers; such as the peach, the vine.

Compound and jointed leaves, that is to say, those whose leaflets are attached by a joint to the common petiole, are those which especially ex-

hibit these remarkable motions. Thus, by night, the leaflets of a great number of leguminous plants, whose leaves are all jointed, have a diffe-rent position from that which they occupy during the day. To this singular phenomenon, Linnæus gave the name of the sleep of plants. For example, at sunrise, the leaflets of the acacia are spread out nearly horizontally; but in proportion as he ascends above the horizon, the leaflets become gradually more erect, so as to be nearly vertical. On the contrary, they begin to droop as soon as the day is on the decline.

Other plants too exhibit similar phenomena, which to us appear to depend on the influence of light. This, in fact, is what we are warranted to conclude from the ingenious experiments of M. De Candolle. This able botanist placed in a darkened cellar, some plants with compound leaves, and thus, by withdrawing them from the influence of light by day, and exposing them to a strong one by night, he succeeded in causing some of them to change their hours of sleeping and waking.

But the leaves of certain vegetables execute motions of irritability, which cannot be referred solely to the influence of light. Of this number is the sensitive plant. The slightest shock, the air gently agitated by the wind, the shadow of a cloud or of any other body, the action of the

electric fluid, heat, cold, irritating vapours, such as those of chlorine, of nitrous gas, are sufficient to make its leaflets perform the most singular motions. If you touch one of them, it becomes erect, and applies itself to that which is next above it on the petiole; all the others will soon perform the same motion, and thus they will cover each other like the tiles of a house. Soon after, the entire leaf will bend towards the earth. But in a short time, if the cause which has produced this effect will cease to act, all those parts which before appeared withered, will soon resume their natural appearance and position.

The hedysarum gyrans, a singular plant, which is a native of Bengal, furnishes an example of very remarkable motions. Its leaves are unifoliolate, accompanied laterally by two smaller stipules. The two stipules enjoy a double motion of flexion and of twisting on themselves, which appears to be independent in each. In fact, one of them sometimes moves rapidly, while the other is in a state of repose. This motion is performed without the application of any outward stimulus; nor is it suspended even by night. That of the middle leaflet, on the contrary, appears to depend on the action of light, and ceases when the plant is no longer exposed to it.

The leaflets of the porliera approach and em-

brace one another, whenever the sky is covered with clouds.

The dionæa muscipula, a native of North America, has at the extremity of its leaves two lobes united by a kind of hinge. When an insect, or any other body, touches and irritates one of the small glandular organs, which are observed on their upper surface, the two lobes become suddenly erect, approach one another, and seize the insect which was the cause of the irritation. Accordingly, the plant has received the vulgar name of fly trap. But it is necessary to remark, that there is no part of this leaf irritable but the two or three small glandular points, which are seen on its upper surface.

M. Du Trochet, of whom we have already made honourable mention in the course of this Work, has been much engaged in examining the motions of the leaves of vegetables, and more particularly of the sensitive plant. We shall here briefly state the results of his investigations.

At the base of the petiole of jointed leaves, which alone exhibit motions of irritability, is perceived a swelling or collar, which ends in a manifest contraction. Heretofore, it was supposed, that the motions took place in this contracted part, which was considered as similar to the articulation of the limbs of animals. The experiments of Du Trochet tend to prove that the mo-

tions have their seat in the collar itself, and that they consist only in bending down and in returning again to the erect position. In the first case it forms a curve, whose convexity looks upwards; in the other case it is nearly straight. This collar is essentially composed of a fine and delicate cellular tissue, furnished with a large quantity of small greenish grains, which, in the opinion of M. Du Trochet, are so many nervous corpuscles. In its centre there is a bundle of nutritious vessels. The cellular tissue which composes the collar, is the seat of the petiole's motion, which may be annihilated by removing that tissue. Thus, when the cellular tissue is removed from the under side of the collar, the leaf continues bent downwards and cannot become erect. If, on the contrary, its upper part be removed, the leaf retains the power of raising itself, but cannot bend downwards. It follows clearly from this experiment, that the bending of the leaf is produced by the upper part of the collar, and its erection by the lower part. These may be compared to two antagonist springs, one of which becomes alternately stronger than the other.

Wishing to study more carefully the internal organization of the swelling, the able experimenter, whose opinions we are now stating, made another discovery. On removing a very thin slice of the cellular substance from the upper

part of the collar, it is seen to immediately bend into a circle, whose concavity is always turned towards the axis of the protuberance. If the same operation be repeated on the under surface, the concavity of the circle also looks towards the centre, so that the collar is composed of two antagonist springs, which have a tendency to bend in opposite directions. The lower spring extends the petiole, while the upper one bends it. M. Du Trochet gives the name of incurvation to this property of the layers of cellular tissue, of bending either in the one direction or in the other.

The immediate cause of these motions of incurvation resides, according to our author, in the nervous action, which is brought into play by external agents. It was natural that M. Du Trochet, having attributed to vegetables a nervous system, similar to that of animals, should make it perform in vegetable life the same important office which it is known to discharge in the life of the animal. Thus then, the action of the nervous system is the cause of the visible motions of vegetables, as well as of animals. But if this be so, their nervous system, as well as that of animals, ought to be the organ of transmitting those motions, or in other words, the part that transmits the stimulus that brings those motions into play. Now, by M. Du Trochet's own confession, this is

not the fact; for by very delicate experiments he has succeeded in proving that the nervous action which produces the motions of leaves, is transmitted solely by the vessels that form the medullary tube, vessels which are wholly destitute of nervous tubercles; so that thus the nervous system of vegetables would be the agent of their nervous power without being the organ of transmitting that power.

From this brief statement, it appears that the important question respecting the cause of the motions of the leaves of vegetables, is not yet completely solved, and that new experiments are still necessary to arrive at a satisfactory solution.

Of the Fall of the Leaves.

A PERIOD arrives every year when most vegetables are stripped of their leaves. This usually occurs at the end of summer, or at the beginning of autumn. This event, however, does not take place at the same period in all vegetables. In general it may be remarked, that the trees whose leaves are the earliest expanded, are also the first to lose them, as in the case of the lime tree, of the horse chesnut, &c. The elder, however, forms an exception to this rule; for its leaves appear very early, and are late in falling. The common ash presents another peculiarity; its leaves appear

very late, and fall towards the end of summer. Leaves which have petioles, particularly those which are jointed on the stem, are detached sooner than those which are sessile, and for a much stronger reason, than those which are amplexicaul. In general, the leaves of annual or perennial herbaceous plants die with the stem, without being detached from it.

But there are trees of various sizes which remain always adorned with their foliage. These are, in general, resinous plants, such as pines, firs, &c., or certain vegetables whose leaves are stiff and coriaceous, such as myrtles, alaterni, rose laurel, &c. These have received the name of evergreens.

Although the fall of the leaves generally takes place at the approach of winter, yet we are not to consider cold as the principal cause of that phenomenon. It should be ascribed more naturally to the suspension of vegetation, to the want of nourishment which the leaves experience at that period of the year, when the course of the sap is interrupted. The vessels of the leaf become contracted and dry, and, soon after, that organ is separated from the branch on which it has been developed.

The Uses of Leaves in Medicine and in Domestic Economy.

A GREAT many vegetables are cultivated in our kitchen gardens on account of their leaves, which furnish excellent articles of food. For this purpose we frequently employ cabbage, spinage, common sorrel, celery, cardoon artichoke, and many other species.

The leaves which are used in medicine are chiefly those possessed of emollient, tonic, stimulant, narcotic, and purgative qualities.

CHAPTER V.

OF STIPULES.*

STIPULES are organs accessory to leaves. They never exist in monocotyledonous vegetables, but only in the dicotyledonous, which, however, are not all possessed of them. They are small, scaly, or leafy appendages, which are met with at the origin of leaves upon the stems. Their number is usually two, one at each side of the petiole, as

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* Stipula, fulcra.

in the horn beam, the lime tree. In general they are free, that is to say, they do not adhere to the petiole; but sometimes they are connected with the base of that organ, as in the rose.

Stipules furnish excellent characters for the construction of natural orders. When a vegetable of any natural family is possessed of them, it is exceedingly rare that all the others of the same family are not equally provided with them. Thus they are found in all the plants of the families of the leguminosæ, of the rosaceæ, of the tiliaceæ, &c.

As they very easily fall off when free, we are apt to be imposed upon with regard to their existence, and to suppose that the plant is not possessed of them; but this error can be easily avoided by observing, that they leave on the point of the stem, which they occupied, a small scar, which bears testimony to their previous existence.

In the exotic rubiaceæ with opposite leaves, such as the coffee tree, psychotria, cinchona, the stipules are placed between the leaves, and appear to be true abortive leaves. In fact, in the rubiaceæ of our climates, such as the different species of galium, rubia and asperula, they are replaced by true leaves, which in that case form a whorl around the stem.

Some plants have but a single stipule, as the common Barbary (berberis vulgaris.)

When there are two, they are almost always distinct from each other ; but sometimes they become united, and are then connate (stipulæ connatæ,) as in the hop (humulus lupulus.) Stipules may be united within the axilla of the leaf, the stem lying without it; in this case the stipules are axillary, as may be seen in the melianthus major.

It is very probable that the membranous sheath of the polygoneæ, which has received the name of ochrea, is formed by the union of two stipules.

The nature and consistence of stipules are very variable. Thus they may be foliaceous, that is to say, similar to leaves, as in the agrimony (agrimonia eupatoria ;) membranaceous as in the fig, the magnolia; spinescent, as in the jujube tree (zizyphus vulgaris,) in the gooseberry (ribes grossularia.)

Their figure is equally variable with that of leaves. Thus they may be orbicular, oval, sagittate, reniform, &c. Besides, they may be entire, toothed or laciniated.

With respect to their duration, some are fugaceous, that is to say, they fall before the leaves; for example, those of the fig (ficus carica,) of the lime tree (tilia europæa.) Others are only caducous, when they fall at the same time with the leaves. This is what happens in most instances.

Lastly, there are others which remain on the stem for a longer or shorter time after the fall of the leaves; such as those of the jujube tree, of the gooseberry, &c.

The use of stipules appears to be, to protect the leaves before their developement, as is clearly shewn by their relative situation in the buds of the amentaceæ, of the rosaceæ, &c.

CHAPTER VI.

OF TENDRILS (CIRRHI.)

By this name are designated appendages which are usually filamentous, of various origins, either simple or branched, winding spirally around neighbouring bodies, and thus serving as a support to the stems of feeble and climbing vegetables.

Tendrils are never any thing but abortive organs. Sometimes they are floral peduncles, which have been considerably elongated, as in the vine; and accordingly they are sometimes observed to bear flowers and fruit. At other times they are petioles, as in many species of lathryus, of vicia, &c. And lastly, they are sometimes stipules or abortive branches. Very often, the extremity of the leaves themselves are rolled up

in such a manner as to form a species of tendrils, as in the pink.

The relative situation of tendrils deserves to be particularly attended to; for it indicates the organs for which they are substituted. Thus, in the vine they are, like the flower stalks, opposite to the leaves, which shews them to be abortive racemes; they are axillary in the passion flowers; of the nature of petioles in the lathyrus latifolius, in fumaria vesicaria; of the nature of peduncles in the vine; of the nature of stipules in certain species of smilax. Lastly, they may be either simple, as in the bryony, or branched, as in the cobæa scandens.

The name of claws is given to the roots of sarmentaceous and climbing plants, which sink into the bodies that support them, like those of the ivy, of the bignonia radicans. The very fine filaments which are observed on the surface of the claws are called suckers, and they appear destined to absorb the nutritious fluids contained in the bodies in which they are implanted.

CHAPTER VII.

OF SPINES AND OF PRICKLES.

Spines (spinæ,) are sharp pointed organs, formed by a prolongation of the inner substance

of vegetables, while prickles (aculei,) arise only from their outer surface, that is to say, from their epidermis, from which they can be detached with the greatest ease.

The origin and nature of spines are not less variable than their situation. They are substituted for leaves in certain species of African asparagus, for stipules in the jujube tree, in the gooseberry, &c. Very often, they are only abortive branches; for example, in the sloe tree. Accordingly, if this tree be transplanted into a richer soil, its spines are converted into branches, The trunks of some trees are covered with spines, which renders them inaccessible; such are the different species of gleditschia. The persistent petioles of the astragalus tragacanthus are converted into spines.

According to their situation and their origin, they are cauline when they grow upon the stem, as in the different species of cactus, of gleditschia, &c.

Terminal, when they are developed at the extremities of branches, as in the sloe tree.

Axillary, when they are situated in the axilla of leaves, as in the limon tree (citrus medica.)

Infra-axillary, when they grow beneath the leaves and the branches, as in the gooseberry.

Lastly, they may be simple, branched, solitary or fasiculated.

Prickles have been considered by some phy-

siologists as hardened hairs. They adhere very slightly to the parts on which they grow, and may be detached from them with the greatest ease, as may be observed in the rose.

Their modifications, derived from situation, form, &c. are the same with those of spines.

OF NUTRITION

IN VEGETABLES.

We have now studied all the organs of vegetation, that is to say, all those which are subservient to the growth and formation of the vegetable. Let us next examine the manner in which nutrition is effected; what share each of those organs in particular takes in it, and what are the conditions necessary for its performance.

Nutrition is a function, whereby vegetables assimilate a part of the solid, liquid, or gaseous substances contained in the bosom of the earth, or diffused through the atmosphere, and which they absorb either by the minute extremities of their radicles or by means of the green parts which are developed in the air.

The absorption of these substances, and their introduction into the vegetable tissue, is effected by a peculiar power of suction, which those different parts are endued with. We shall first explain the suction or absorption carried on by the

roots in the bosom of the earth, and by the leaves and the other green parts in the atmosphere; and we shall then describe the course of the sap or of the nutritious juices from the root to the leaves. We shall next examine the phenomena of transpiration, of expiration, and of excretion, and we shall afterwards pursue the sap in its retrograde course from the leaves towards the roots.

Of Absorption.

It has been already stated, that the roots, by the minute extremities of their fibrils, absorb from the earth the fluids and gases which are diffused through it. But all the green parts of vegetables, such as the leaves, the young branches, &c., are equally endued with a very remarkable power of absorption, and also contribute to the performance of that important function.

The capillary radicles which are buried in the earth, draw from it, by the spongioles, or open mouths which terminate them, the moisture with which it is impregnated. Water is the necessary vehicle of the nutriment of vegetables. It does not, as was the opinion of the ancients, constitute the basis of the food of vegetables; but it serves as a solvent, as a menstruum, for the bodies which they are to assimilate. In fact, if a plant be withdrawn from every foreign influence, and

be made to vegetate in distilled water, it will very shortly perish. Water alone will not, therefore, serve for its nutrition. It must contain other principles which are foreign to it. Besides, do not vegetables contain carbon, gases, earths, salts, and even metals in the state of oxides, or in combination with acids? Now it is clear that water cannot be the source of these different substances. Let us, therefore, see by what means they have been introduced into the body of the plant, of which they form a constituent part.

How has carbon been introduced into vegetables? It cannot be in a pure and isolated state; for as such it is very rare in nature, and is insoluble in water. But every one is aware of the great affinity of carbon for oxygen; it is well known, that the carbonic acid, which results from their union, is very abundantly diffused in nature; that it exists in the bosom of the earth, and in the manure which is mixed with it; that, being very soluble in water, that fluid always contains a certain quantity of it. It is, therefore, in the state of acid that carbon is conveyed into the substance of vegetables. Now, it was formerly stated, that when exposed to the action of the sun's rays, vegetables have a power of decomposing carbonic acid, whose carbon they retain and assimilate, while, at the same time, they reject the greatest part of its oxygen. Water, therefore, can serve

only as a vehicle to this alimentary matter of vegetation.

Oxygen also, is one of the constituents of vegetable substances. It is easy to account for the presence of oxygen in vegetables. In fact, it has been proved by the experiments of Theodore de Saussure, that they do not reject the whole of the oxygen that acidified the carbon, but that they retain a certain quantity of it. The atmospheric air which circulates in vegetables, also gives them a portion of its oxygen; but it is water chiefly that supplies them at once with the greater part of their oxygen, and with the whole of the hydrogen which they contain in so large a proportion. In order to supply those elements, that liquid undergoes decomposition in the vegetable tissue, a decomposition, for which the ordinary laws of chemistry can as little afford a satisfactory solution, as for that of carbonic acid.

Nitrogen, which is also found in vegetable substances, clearly derives its origin from the decomposition of atmospheric air within the body of the plant.

Such are the different inorganic substances, which enter essentially into the composition of the vegetable tissue; these are the substances that constitute the basis of it. But there are others also, which without forming a necessary

part of their organization, they always contain in more or less considerable quantities; such are lime, silica, carbonate, phosphate and malate of lime, the carbonates of soda and potash, &c. Now it is proved by the experiments of Theodore de Saussure, that these substances enter ready formed into the body of the vegetable. Contained in the bosom of the earth or in the atmosphere, they are dissolved or suspended in water, which conveys them into the interior of the vegetable tissue.

These substances are not produced by the act of vegetation, as has been supposed by some botanists and natural philosophers. The earth, or the medium in which the vegetables grow, supplies them with the alkalies, earths, and metallic substances, which chemical analysis discovers in them. This fact, which was sufficiently proved by the numerous experiments of Theodore de Saussure, has received the strongest possible confirmation from the recent experiments of M. Lassaigne. This young and able chemist, repeated in the following manner the experiments of Theodore de Saussure.

On the second of April, he placed fifteen grains of buck wheat (polygonum fagopyrum,) in a platinum capsule, containing some washed flowers of sulphur, which he had moistened with distilled water, recently prepared, and he then covered

the whole with a glass bell, to the upper part of which was adapted a stopcock, which, by means of a glass tube curved like a siphon and terminating in a funnel, enabled him from time to time to pour water upon the sulphur. At the end of two or three days, the greater part of the seeds had germinated. They continued to be watered daily, and in the space of fifteen days they produced stems of about two inches long, which were covered with a great many leaves.

These, together with the seeds which had not germinated, were carefully collected and reduced to ashes in a platinum crucible. The ashes obtained from them weighed about three grains and one third. These, in 220 parts, contained 190 of the phosphate of lime, 25 of the carbonate of lime, and five of silica.

Fifteen grains of the same seeds being incinerated, yielded the same quantity of ashes, which were composed precisely of the same ingredients.

It clearly follows from this experiment, which was repeated a second time with the same result, that after their developement in distilled water, the young plants of buck wheat did not contain a greater quantity of alcaline salts than the seeds from which they were raised. Whence we may conclude, with Theodore de Saussure, that the alkalies and earths contained in vegetables have been absorbed and taken in from the soil.

But what is the power that enables roots to absorb? The laws of physics and mechanics are not sufficient to explain the phenomenon. The extraordinary force with which absortion is carried on cannot be satisfactorily accounted for, without admitting a vital force and energy inherent in the vegetable tissue, and producing, by its influence, whose nature is unknown to us, the visible phenomena of vegetation.

To the celebrated Hales we are indebted for the most ingenious and accurate experiments, which serve to demonstrate the prodigious force of absorption possessed by the roots and branches of vegetables. He layed bare one of the roots of a pear tree, cut off its point, and adapted to it one extremity of a tube full of water, whose other extremity was immersed in a mercurial trough. In six minutes the mercury rose eight inches in the tube.

Hales, in order to measure the force with which the vine absorbs moisture from the earth, made an experiment, whose results might appear erroneous and exaggerated, if they had not been afterwards verified by Mirbel, who repeated the experiment. The English naturalist, on the 6th of April, cut a vine stem without branches, of about eight lines in diameter, at the distance of thirty-three inches from the ground. To this he adapted a tube of double curvature, which he filled with

mercury up to the curvature that surmounted the transverse section of the stem. The sap which issued from the stem had sufficient force to raise the column of mercury, in a few days, thirty-two inches above its own level. Now the weight of a column of air of the height of the atmosphere, is equal to that of a column of mercury of twenty-eight inches, or of a column of water of about thirty-three feet. In this case, therefore, the force with which the sap ascended from the root into the stem, was much greater than the pressure of the atmosphere.

A great many facts and experiments demonstrate the part that leaves take in the office of absorption. Thus, a branch detached from the tree on which it grew, still absorbs with great force the fluid in which it is immersed by its lower extremity. If the top of the branch, instead of its lower extremity, be plunged into water, the absorption will not be thereby diminished.

In summer, we observe the plants which adorn our parterres to droop and to wither from the heat of the sun; but if examined by night or in the morning, they are found to have acquired both freshness and vigour from the dew which is absorbed by their leaves.

If we strip a vegetable of all its leaves it will shortly perish; because the absorption of its roots

alone will not be sufficient to supply all the materials of its nutrition.

In many plants, particularly in the different species of cactus, and in other succulent plants, whose roots are very small, and which usually vegetate on rocks and in the moving sands of deserts, it is clear, that the absorption of nutritive fluids is effected almost exclusively by the leaves and the other parts surrounded by the atmosphere; for the smallness of their roots, and the extreme dryness of the soil in which they grow, would not be sufficient to make them vegetate.

From what has been now stated, we see how great is the absorbing surface of vegetables compared with their entire bulk. It is incomparably greater than that of animals.

§ 2. *Of the Course of the Sap.*

The sap is that colourless and essentially aqueous fluid, which the roots absorb from the earth, and the leaves from the atmosphere, that it may serve for the nutrition of the vegetable. Holding the nutritive principles in solution, it deposits them in the different parts of the vegetable as it circulates through them.

The ancients disputed much about the part of the stem through which the sap ascends. Some believed it to be the pith; others, on the contrary,

thought that the bark was the seat of that singular phenomenon. But, when recourse was had to positive experiments, it was proved that both these opinions were equally erroneous. In fact, the sap ascends through the woody layers. The lymphatic vessels of the wood and of the alburnum are the channels which serve to convey that nutritive fluid. But the chief seat of its ascent appears to be the part which is next to the medullary tube. In fact, if a branch or a young vegetable be immersed in a coloured fluid, it will be absorbed, and traces of it will be visible, particularly in those vessels which are nearest to the medullary tube; but none whatever in the pith or in the bark. This fact was accidentally discovered by Coulomb. That naturalist was felling a row of large poplars in full vegetation. On one of these, which was sawed circularly at its base, and overturned, but which was still connected with the stock by its centre, he observed bubbles of liquid and of air ascend from the broken fibres, accompanied with a very audible noise. He afterwards tried experiments on the trees which remained to be cut down. Thus, by causing them to be bored, he observed that the fragments removed from the outer layers of the wood were nearly dry, and that as the instrument advanced they became more humid, until it approached the centre, when the sap began to flow out in great

abundance. These experiments were presented to the Academy of Sciences, and were repeated by M. M. Des Fontaines and Thouins, who established their accuracy. Thus, then, it is clearly proved that the sap ascends by the woody layers, and particularly by those which are nearest to the medullary tube. It has been also proved by experiment, that the ascent of the sap is not prevented in trees which are stripped of their bark, and in which the pith is more or less obstructed; whereas, by removing the whole of the woody layers, it entirely ceases. Yet it may still be continued if there remain but a small cylinder of wood, as may be observed in hollow trees, and chiefly in willows, whose trunk is generally carious within. By thus passing through the layers of wood in its course upwards, the sap communicates with the lateral parts and branches of the stem, either directly by the anastomosis of their vessels, or by diffusing itself gradually through pores in the parietes of the canals which convey it. The water which constitutes its basis, being loaded with the principles of nutrition and repair, is stripped of them in its course, and deposits them in the vegetable tissue.

In formerly speaking of the absorption of roots, we quoted the experiments of Hales, to prove the great force with which the sap ascends in a stem, even of small diameter; inasmuch as

that force acts with more power on the mercury than a column of air equal to the height of the atmosphere. Bonnet also instituted experiments with a view to ascertain the velocity with which the sap moves upwards. For this purpose, he immersed some young plants of kidney bean in coloured fluids, and in these he observed the fluids to ascend, sometimes half an inch in half an hour, sometimes three inches in an hour, and sometimes four inches in three hours.

It follows from the observations and experiments of Professor Amici of Modena,* that the fluids contained in the vessels, or in the areolæ of the cellular tissue of plants, move and circulate in a perfectly independent manner in each of those cells or vessels. He says that each cavity constitutes a distinct organ, and that in this cavity the fluid moves circularly, independently of a distinct circulation which is going on at the same time in each of the adjacent cavities. It was chiefly on the chara vulgaris and flexilis, and on the caulinia fragilis aquatic plants, whose organization, on account of the transparency of their textures, is easily seen, that the Professor of Modena made his observations. During his visit to Paris in the year 1827, I have seen at Professor

* Annales des Sciences Naturelles, tom. ii.

Amici's, by means of his admirable microscope, a great number of the facts which have served as a basis to his observations. The motion of the sap in each cavity of the cellular tissue, or in each vessel, may be perceived through the means of small solid particles floating in that fluid. These particles, which are exceedingly minute globules, sometimes of a vivid green colour, are seen ascending along one of the walls of the cavity. Having arrived at the horizontal partition which separates that from the one that lies over it, it changes its course, moves in a horizontal direction to the opposite side of the cell, where it descends to the bottom of the cavity. Here, again, its course becomes horizontal until it reaches the point from which it started, in order to commence its course anew. From this it follows, that in the same vessel there are always four different currents; an ascending and descending current, and two horizontal ones in opposite directions.

It is a very remarkable fact, that the direction of the motion in each vessel seems to have no connexion with that which exists in the surrounding tubes. Thus, sometimes, two vessels which are in contact will exhibit the same motion, while the motion of the fluids in those around them, will have quite an opposite direction.

The same philosopher has also remarked, that

the moving globules are never seen to pass from one cavity into another. "Yet," he says, "I do not pretend to say that the juices contained in a vessel do not pass, when circumstances require it, into those surrounding it. On the contrary, I am persuaded that this transfusion is necessary for the growth of the plant. But the most subtile and fluid parts alone of the juices can penetrate invisibly through the membrane, by passing through pores which the eye, even armed with a microscope, cannot discover."

What is the cause of this independent motion of the fluids in each organized part of the vegetable? Some have ascribed it to the irritability of the membranes, which forms the tubes; but Amici does not agree in this opinion. He thinks he can discover the cause of their motion in a species of green or transparent granules which line the walls of the tubes, where they are disposed in rows or beads, and, by an action similar to that of the voltaic pile, communicate motion to the fluids. These green grains are obviously the same with those which Du Trochet considers as the nervous system of vegetables, and which, as we have already mentioned, are only globules full of a green matter.

But what is the cause of the ascent of the sap? How can this fluid ascend from the root to the upper part of the stem? We may well suppose

that among the old writers on Botany, every man entertained a theory of his own, in order to explain this wonderful phenomenon.

Grew discovered the cause of it in the play of Utricles. This author, who considered the vegetable tissue as composed of utricles placed in juxta position, and communicating with each other, supposed that as soon as the lower utricles receive the sap, they contract and force it into those which lie immediately above them, and that, by this mechanism, the sap at last arrives at the top of the vegetable.

Malpighi, on the contrary, ascribed it to the alternate condensation and rarefaction of the sap by heat.

De La Hire, who believed that the sap vessels were furnished with valves, like the veins of animals, supposed it to depend upon their organization.

Perault believed it was produced by a kind of fermentation.

And lastly, others, and these are the greatest number, have compared the course of the sap to the ascent of fluids in capillary tubes. But it is easy to see the insufficiency of such hypotheses to account for the phenomenon in question. If, for instance, it depended on the capillary attraction of the sap vessels, it ought to be independent of external circumstances, and even of the life of the vegetable. Now this is not the

fact. Every one knows that the sap never circulates in a vegetable deprived of life. The vital principle has, therefore, a direct and powerful influence on the exercise of that function. As in regard to the absorbing power of roots, we have admitted a peculiar vital principle on which all the phenomena of vegetables depend, a force which constitutes the distinctive character of living beings, and withdraws them from the influence of physical and chemical causes; so we are also obliged to have recourse to it in order to account for the ascent of the sap. If, in fact, all the phenomena of vegetation were produced only by the action of physical or chemical causes, by what characters should we be able to distinguish vegetables from inorganic beings? We must, therefore, in vegetables as well as in animals, admit a vital power which presides over all their functions. But although this vital power be the true cause of the sap's ascent in the vegetable, yet certain other internal and external causes may assist in promoting it.

Among the external causes we may class temperature, and the influence of light and of electricity.

It is generally known that a warm temperature is particularly favourable to the flow of the sap. During winter, in fact, the tree is gorged with it, but then it is thick and stagnant: in

spring, however, on the return of heat, the sap begins to ascend in those vessels which before appeared to be choked with it.

Light and electricity have also a marked influence on the flow of the sap. It is known that an atmosphere long charged with electricity, is very favourable to the growth of vegetables, and this necessarily supposes that the sap ascends in them with increased force and velocity.

Certain internal causes, that is to say, inherent in the vegetable, appear also to favour the ascent of the sap; such as the more or less considerable quantity of cortical pores in the vegetable, and its greater or less extent of surface. These two circumstances clearly increase the force and velocity of the circulation of the nutritive juices of vegetables.

We have now seen by what force and by what organs the sap ascends from the roots of vegetables towards the extremities of all their branches. Here a new set of phenomena present themselves, and a new circulation commences.

In fact, as soon as the sap arrives at the extremities of the branches, it diffuses itself through their leaves. There it loses some of its old principles, and acquires new ones. The leaves and the other green parts are the seat of vegetable transpiration, expiration, and excretion. In these

the sap is freed from its atmospheric air, its superfluous water, and from other substances which are either foreign to or useless for vegetable nutrition. But at the same time that it thus loses a part of the principles which composed it before, it acquires new qualities, and pursuing an opposite course to that which it has already run, it descends from the leaves towards the root through the liber, and the vegetating part of the cortical layers.*

Let us now examine all the phenomena that occur in the leaves in consequence of the sap's ascent.

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* In the year 1828, M. Du Trochet published the results of some inquiries into the nature of a power which he thinks will afford a solution for many of the phenomena of vegetable life, and particularly for the ascent of the sap. The existence of this power is proved by a simple experiment. A small quantity of syrup, or of gum water, is introduced into the cæcum of a fowl, which is then closed and immersed in pure water. This little bag soon begins to swell, and in due time becomes fully distended with fluid. It is clear that the water in contact with the outer surface of the cæcum, must have passed into its cavity through the intermolecular pores, as it contains no other. This power of transudation inwards, has received from M. Du Trochet the name of endosmose, and belongs not only to the cæcum of fowls, but even to the pods of leguminous vegetables, and, in general, to all organized tissues.

For the exertion of this power, it is necessary that the inner fluid should be denser than the outer; for otherwise its quantity will be diminished by exosmose or transudation out-

§ 3. *Of Transpiration.*

Transpiration, or the aqueous exhalation of vegetables, is that function whereby the sap, when it enters the leaves, is deprived of its superabundant water.

This water is usually exhaled into the atmosphere in the form of vapour. When the transpiration is slow, the vapour is dissolved in the atmosphere as soon as it is formed; but if the quantity be increased in a low temperature, the exhaled fluid is observed to collect in minute drops, which, by uniting, form others of very considerable magnitude. Thus, at sunrise, we

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wards. Both these operations are greatly promoted by the influence of heat and of electricity.

If the little bag containing the syrup be connected with one end of a glass tube, which is open at both extremities, the fluid will be observed to ascend with a velocity and force which will vary with circumstances, and the latter of which was, in one instance, estimated as equal to the pressure of four atmospheres. It is obvious that the ascent of the fluid in this experiment is analogous to that of the sap in vegetables, and as the force of ascent is much greater than that assigned by Hales to the sap of the vine stem, it affords a satisfactory explanation of that phenomenon.

For a fuller account of these experiments, see Edinburgh Medical and Physical Journal, for April 1829.

often find what are called limpid dew drops, hanging from the tops of the leaves of several grasses. They are also very evident on cabbage leaves. They were long supposed to be the effect of dew; but Musschenbroek first proved, by conclusive experiments, that they arise from vegetable transpiration, whose vapours are condensed by the coolness of the night. He cut off the communication of a poppy with the surrounding air, by covering it with a glass bell, and with the surface of the earth, by covering the vessel in which the plant grew, with a plate of lead. On the following morning the drops were found on the plant as usual.

Hales also tried experiments to ascertain the proportion between the water absorbed by the root, and that which is exhaled by the leaves. He placed in a varnished vessel, a plant of the helianthus annuus (the common sun flower,) covered the vessel with a plate of lead, in which there were two holes, the one for the passage of the stem, and the other for the supply of water. He accurately weighed this apparatus for fifteen successive days, and observed, that the mean quantity of water expired during the twelve hours of day, was about twenty ounces. Hot and dry weather greatly increased the transpiration, for, under those circumstances, it rose to thirty ounces. On the contrary, an atmosphere loaded with

moisture, very sensibly diminished the quantity. Accordingly, it never exceeded three ounces by night, and if the night were cold and humid, it became almost insensible.

These experiments have been since repeated by M. M. Desfontaines and Mirbel, who have again had occasion to admire the correctness and sagacity of the English naturalist.

Senebier has proved, by repeated experiments, that the quantity of water expired was to that absorbed by the vegetable in the proportion of two to three ; which also demonstrates, that a part of that fluid becomes fixed or decomposed within the vegetable.

These facts prove incontestably, 1°. that vegetables transpire by their leaves, that is to say, that they reject a certain quantity of aqueous fluid. 2°. That this transpiration is greater as the weather is hotter and dryer, whereas in moist weather, and particularly by night, the process is almost suspended. 3°. That this function proceeds with greater activity, in proportion as the plant is young and vigorous. 4°. That nutrition proceeds the better as transpiration holds due proportion to absorption ; for when one of these functions is carried on with more vigour than the other, the vegetable begins to languish. This is what may be observed, for instance in those plants which, from being exposed to the burning heat of

the sun, lose their freshness and vigour, because the quantity of fluids transpired is not in due proportion to that which is absorbed by the roots.

§ 4. *Of Expiration.*

It has been formerly stated and proved, that vegetables absorb or inspire a certain quantity of air or of other elastic fluids, either directly or mixed with their sap, that is to say, both by means of their roots and of their leaves. Now that portion of those fluids which has not been decomposed to serve for vegetable nutrition, is what forms the matter of expiration. Plants, therefore, as well as animals, have a kind of respiration, consisting also of two parts, of inspiration and of expiration; yet with this remarkable difference, that in them it is unattended with any disengagement of caloric. This function becomes very manifest by immersing the branch of a tree, or a young plant, in a glass bell full of water, and then exposing it to the action of light. A great number of small bubbles will be seen rising from its surface, which are almost wholly composed of oxygen gas. But if this experiment were conducted in a dark place, the leaves, instead of oxygen gas, would expire carbonic acid and nitrogen. Here, however, it deserves particular attention, that all the parts of a vegetable which

are not of a green colour, such as the root, the bark, the flower, the fruit, when made the subjects of similar experiments, instead of oxygen, always disengage carbonic acid. It follows, therefore, that the expiration of oxygen gas depends not only on the direct influence of the rays of light, but also on the green colour of the parts.

We know that vegetables absorb a great quantity of carbonic acid, which they decompose, when exposed to the sun's light, and disengage the greater part of the oxygen which was combined with the carbon.

When a plant is either dead or languishing, its expiration either wholly ceases, or else the expired fluid is always nitrogen. Some vegetables, even when exposed to the direct solar rays, expire nothing but azote ; such as the sensitive plant, holly, the rose laurel, and some others. It appears to us very difficult to point out the true cause of this anomaly.

§ 5. *Of Excretion.*

Vegetable excretions are fluids of more or less thickness, sometimes capable of being condensed or solidified. They are of very various natures ; such as resins, wax, volatile oils, saccharine matter, manna, fixed oils, &c. All these substances are thrown out by the force of vegeta-

tion. Thus, in Calabria, the fraxinus ornus and several other species of ash, exude a thick and saccharine liquid, which concretes by the action of the air, and forms manna. Pines, firs, and in general, all the trees of the family of the coniferæ, furnish considerable quantities of resinous matters. Many vegetables, such as the ceroxylon andicola, a superb species of palm, described by Humbold and Bonpland, the myrica cerifera of North America, yield a large quantity of wax, which is applied to useful purposes by the natives of the countries in which they grow.

Roots also excrete by their minute extremities certain fluids, which are either noxious or useful to the plants that vegetate around them. It is thus that we are able to explain the sociableness or antipathies of certain vegetables; for instance, it is known that the creeping thistle injures the oat, erigeron acre, the wheat, scabious, flax, &c.

Such are the different phenomena depending on the sap, on its arrival in the upper part of vegetables. Let us now pursue its retrograde course from the leaves towards the roots.

§ 6. *Of the Descending Sap.*

This point has been the subject of a great many discussions among physiologists. In fact,

many of them had long denied the existence of a descending sap. But the visible phenomena of vegetation, and the most accurate experiments, have demonstrated the existence of a second sap, which pursues an opposite course to that which we have formerly examined. Thus, if a strong ligature be applied to the trunk of a dicotyledonous tree, a circular swelling will be produced above it, which will become gradually larger. Now can this swelling be produced by the sap which ascends from the roots to the leaves? In that case it should appear below the ligature, not above it. But the contrary is the fact. The swelling, therefore, can arise only from the obstacle opposed to the juices descending, through the cortical layers from the upper to the lower part of the vegetable.

The descending sap, being deprived of the greater part of its aqueous principles, being much more elaborated, and containing more of nutritious matter than the former, contributes essentially to the support of the vegetable. As it circulates in the vegetating part of the stem, in that which is alone susceptible of growth, its uses cannot appear very doubtful.

In fact, let us once more examine more closely the effects resulting from the application of a ligature to the trunk of a dicotyledonous tree, and we shall see, not only that there is a swelling

formed above the ligature, but that the part of the stem below it ceases to grow, and that no new layer is added to those that already existed. Now, do we not here see, in the clearest manner, the uses of the descending sap? It continually renews and maintains the cambium; it contributes, therefore, chiefly to the growth and developement of dicotyledonous trees.

But this second sap is not of the same nature in all vegetables. In some it is a white, milky juice, as in the spurges; in others it is yellowish or brownish (papaveraceæ;) in the coniferæ, it is more or less resinous, &c. However, it is necessary to remark, that according to a great many physiologists, the proper juices of vegetables are not the descending sap itself, but fluids which are separated from it in the process of vegetation. The different natures of these juices, their existence in some vegetables only, and their situation in a particular set of vessels, which are few in number, appear to us to be so many proofs in favour of the latter opinion.

We have now passed successively in review the different phenomena connected with or contributing to the nutrition of vegetables. We have seen the juices absorbed by the roots in the earth, conveyed by a peculiar force, depending on the life of the vegetable, to the highest points of the

last ramifications of the stem; there, by mixing with other absorbed fluids, by losing such of their aqueous and aeriform principles as are useless to nutrition, we have found them to acquire new properties, and pursuing a retrograde course, to become the true food of the vegetable.

From this we may see, that nutrition in plants, although agreeing in many respects with the same function in animals, yet differs from it essentially.

Thus, in animals, the different nutritious substances are introduced by the mouth into their bodies. But in vegetables, water mixed with substances either necessary or useless for their nutrition, is taken up from the soil by the open mouths of absorbents which terminate their roots.

In animals, the substances taken in are conveyed in one and the same canal, from the mouth to the place where the truly nutritious part of the aliment (the chyle,) is separated from that which is useless or excrementitious.

The same takes place in vegetables: the fluids absorbed by the root run a certain course before they arrive at the leaves, where a separation is effected between the parts which are useless and those which are necessary for nutrition. Both animals and vegetables eliminate the substances which are unfit for their nutrition.

One of the most striking differences between vegetables and animals is, that the former live al-

most exclusively on inorganic substances, such as water, carbon, hydrogen, oxygen, &c. while in animals, the substances which serve for nutrition are always organized and taken from the animal and vegetable kingdoms.

The chyle, or the nutritive portion of the food of animals, is mingled with their blood; it circulates through all parts of their body, and serves for the nutrition and developement of their organs.

The sap of vegetables, having been exposed to the influence of the atmosphere in the leaves, and having acquired a new nature and properties, descends into all parts of the vegetable, to convey to them the materials of their growth, and to serve for their developement.

SECOND CLASS.

ORGANS OF REPRODUCTION.

The organs of reproduction, which we also call the organs of fructification, are those which are subservient to the preservation of the species, and to the propagation of families. Their office is not less important than that of the organs whose structure and uses we have already considered; for as the one are necessary for the existence of the individual, and for the developement of all its parts, so are the others indispensable in order that the same individual may produce others like itself, for the purpose of renewing and perpetuating its species.

In plants, the flower, the fruit, and the different parts that compose them, constitute the organs of reproduction. Accordingly we have divided them into two sections, namely, the floral organs and the organs of fructification.

SECTION I.

OF THE FLORAL ORGANS.

General Considerations respecting the Flower.

We already know the parts, whose office it is to fix the plant in the soil, and to absorb from

the earth or from the surrounding air the aqueous or elastic fluids necessary for the nutrition and growth of the vegetable. Let us now attend to other organs, equally essential, whose action tends to renew and to perpetuate the species.

Here, we find a great resemblance between animals and vegetables. Both, in fact, are provided with particular organs, which concur, by their mutual action, in performing one of the most important functions of their lives. Generation is the great end for which nature has created the different organs of animals and of vegetables. There is the most perfect analogy between them in this great function. The influence of the male on the female organ is that which produces fecundation, or that change whereby the embryo, while yet in the rudimental state, receives and retains the vivifying principle of life. Here, however, it is necessary to observe the modifications which nature has impressed on these two great classes of organized beings. Most animals come into the world with those organs which are afterwards to serve for their reproduction. These organs remain torpid until the period when nature, by imparting to them new energy, enables them to perform those functions for which she has created them; vegetables, on the contrary, are destitute of sexual organs at their birth; in them they are not developed until the moment when

they are necessary for fecundation. Another great difference between animals and vegetables is, that in the former, the sexual organs may often perform the same function, being produced and perishing at the same time with the animal that bears them ; while, in vegetables, which are of a soft and delicate texture, those organs have but a transient existence : they appear, only to accomplish the ends of nature, and, immediately after, they perish.

We have reason to admire the wisdom of nature in her distribution of the sexes among organized beings. Vegetables, which are unchangeably fixed to the spot that has given them birth, and destitute of the power of locomotion, usually have on the same individual both the organs whose mutual action is necessary for fecundation. Animals, on the contrary, which are endowed with voluntary motion, and may, therefore, move in every direction, have, in general, the two sexes separated, and in distinct individuals.

It is on this account that hermaphrodites are so common in vegetables, and so rare among animals.

The flower is essentially constituted by the presence of one of the two sexual organs, or of both united on a common support, either with or without the external coverings which are destined to protect them.

Reduced to its greatest simplicity, the flower may, therefore, consist of only a single sexual organ, either male or female, that is to say, of a *stamen* or of a *pistil.*

Thus, in the willow, whose flowers are unisexual, the male flower consists only of one, two, or three stamina attached to a small scale. The female flowers are composed of a pistil, which is also accompanied with a scale, without any other accessory organs. In this case, as well as in a great many others, the flowers are as simple as possible, and take the name of male or female, according to the organs that compose them.

The hermaphrodite flower, on the contrary, is that which contains united both the sexual organs, the male and the female.

But the different flowers that we have now examined are not complete. In fact, although the essence of the flower consists in the sexual organs, in order to be perfect, it is necessary that it should possess others also, which, although accessory, are yet a part of it, and serve to promote its functions. These organs are the floral integuments or perianth, that is to say, the calyx and corolla. The complete flower, therefore, shall be that which possesses both the sexual organs surrounded with a calyx and a corolla.

In respect to its primitive organization, it may be said that the complete flower is composed of

four verticils of leaves, variously modified and set very close to each other. We shall, hereafter, unfold this idea, when we shall have made known the different constituent parts of a flower, and their relative situations.

It is important here to examine in what regular order the different constituent parts of a complete flower are disposed with respect to each other.

Proceeding from the centre to the circumference, we shall find the pistil, or the female sexual organ, always occupying the central part of the flower. It consists of the ovary, of the style, and of the stigma. More externally are situated the male sexual organs or the stamina, usually more numerous than the pistils, and composed of a filament and of an anther. Next to the stamens, we find the inner of the two floral integuments, or the corolla. It is called monopetalous when it consists of a single piece; polypetalous, when composed of several pieces, called petals. Lastly, the outer of the two floral integuments is the calyx, which is monosepalous or polysepalous, accordingly as it is composed of one or more pieces, called sepals. Whatever is without the calyx, is not, properly speaking, a part of the flower; such as the floral leaves or the bractes, which very often accompany it, and which ought to be considered only as accessory parts of it.

Let us take a few examples of flowers from nature, in which we shall try to recognise and to name the parts that we have already enumerated. The wall flower (cheiranthus cheiri,) will serve as an example.

We shall find the centre of the flower occupied by a small oblong body, somewhat compressed from before backwards, and, when slit longitudinally in its lower two-thirds, presenting two cavities which contain the ovules. This body is the pistil. It is composed of an ovary or lower part, of a style, which is a filiform prolongation from the top of the ovary, terminating in a small, viscid, glandular, two-lobed body, which is the stigma. Without the pistil we find six organs of the same form and structure, disposed circularly around the female organ, each composed of a lower part in the form of a filament, which is surmounted by a species of small ovate bag, composed of two cells, and full of a yellowish powder. By their position and form, we recognise these bodies as the stamina or male sexual organs. Their lower part is the filament, their upper part the anther; the powder which they contain is the pollen. On examining the parts without the sexual organs, we perceive eight membranous appendages, disposed in two rows, four within, and four occupying the outer part of the flower. Of these, the four inner, which are larger, of a

yellow colour, and perfectly similar to each other, constitute but one organ, which is the corolla. In this case it is composed of four distinct pieces, or of four petals. It will be now very easy to give a name to the four greenish pieces, which are smaller, and situated without the corolla. In fact, we already know that the outer of the two floral integuments is the calyx. Here then the calyx is composed of four pieces or sepals.

Such is the structure and relative position of the different organs which constitute a complete flower. Let us now examine some flowers which do not contain all the organs that we have enumerated. In the tulip, for example, we find the pistil in the centre of the flower, consisting of a prismatic ovary with three sides, whose summit is crowned with a glandular body, which is the stigma : in this instance there is no style. More externally we find six stamina, in whose structure there is nothing remarkable. Here, then, are the two sexual organs. But external to them, we find six membranous pieces or segments, perfectly similar to each other, and evidently forming but one and the same organ. In this flower, therefore, one of the two floral integuments is wanting ; but which of them is it ? This question has much engaged the attention of botanists, who are not quite agreed upon the subject. Thus, some of them, with Linnæus, are of opinion that

if there be but a single floral integument around the sexual organs, it should be called corolla when its colours are vivid, and calyx when the colour is green. It is obvious that this distinction is founded upon characters of little permanency. Others, on the contrary, guided by the laws of analogy, regard it, with Jussieu, as a calyx, whatever may be its colour and consistence. We agree in this opinion, and we shall, therefore, call a single floral integument surrounding the sexual organs a calyx. Other authors, wishing to remedy this diversity of opinions, and, as it were, to conciliate both parties, give the name of perigonium to a single floral integument enclosing the sexual organs. The tulip, which we are now examining, has, therefore, a calyx composed of six sepals, or a perigonium of six distinct pieces.

Lastly, as we have formerly stated, there are some flowers which want both the floral integuments. They are then called naked, to distinguish them from such as are possessed of those integuments.

CHAPTER I.

OF THE PEDUNCLE AND OF THE BRACTES.

The flower may be connected in various ways with the branches or twigs that support it. Thus,

it is sometimes immediately attached by its base, without the intervention of any other organ. In this case it is said to be sessile (flos sessilis.) On the contrary, the flower is said to be peduncled (flos pedunculatus,) when it is attached to it by means of a peculiar prolongation, commonly called a flower stalk, which, in botany, is known by the name of peduncle (pedunculus.) The peduncle of the flower, as well as the petiole of the leaf, may be simple or branched. When branched, each of its divisions bearing a single flower takes the name of pedicle (pedicellus,) and the flowers are said to be pedicled (flores pedicellati.) Thus, the flower of the common pink is peduncled, and each of the flowers that compose the thyrse of the lilach or of the vine is pedicled.

The peduncle or support of the flowers assumes different modifications, which it is necessary to be acquainted with.

Thus, according to its situation, it is radical when it proceeds from the axilla of a radical leaf, as in the dandelion (leontodon taraxacum,) the cowslip (primula veris.)

When it springs immediately from a cluster of radical leaves, it receives she name of scape (scapus,) as in the hyacinth, the narcissus, &c.

It is cauline or rameal, accordingly as it grows on the stem or the branches : this is the most usual disposition.

It is petiolar, when it coalesces in some part of its length with the petiole.

Epiphyllous, when, instead of growing on the stem or on the branches, it takes its origin from the surface of the leaves; such as that of the butcher's broom (ruscus aculeatus.)

Axillary, when it grows, on the stem or branches, in the axilla of leaves.

Extra axillary or lateral, when it grows from the lateral parts near the origin of the leaf, as in the solaneæ.

Terminal, when it terminates the top of the stem, of which it appears to be only a continuation.

The peduncle is one flowered, two flowered, three flowered, many flowered, according to the number of flowers it supports.

It is sometimes rolled spirally, or like a cork screw, as in the vallisneria spiralis; the sow bread (cyclamen europæum) also exhibits this curious phenomenon, when its fruit approaches to maturity.

It frequently happens, that around one or several flowers united, there is a certain number of small leaves, quite distinct from the others in their colour, their form, their consistence, &c. They have received the name of bracteæ. We must not confound the bractes with the floral leaves properly so called. The latter, in fact,

differ but very little from the other leaves of the plant; they are only smaller and closer to the flower. Thus in the salvia horminum, and the salvia sclaræa, the bractes are very apparent, and very distinct from the leaves; they are of a blue colour.

When the bractes or floral leaves are disposed symmetrically around one or more of the flowers, so as to form a kind of accessory integument, they constitute what is called an involucre. Thus, in the anemones there are three floral leaves arranged symmetrically below the flower, which form a triphyllous involucre. The involucre is called tetraphyllous, pentaphyllous, hexaphyllous, polyphyllous, accordingly as it is composed of four, five, six or a greater number of bractes. When the peduncle is divided, and there is at the base of each pedicle a small involucre, it is called partial involucre (involucellum:) for example, in the carrot, at the base of the peduncles there is a polyphyllous involucre, and at the base of the pedicles, an involucellum, which is also polyphyllous.

The bractes are in general free from all adhesion; sometimes, however, they adhere to the peduncle of the flower, as in the lime tree (tilia europæa.)

They have usually the structure and consistence of a leaf; sometimes, however, they are

small scales, which are more or less numerous, and quite close to the flower. If, in this case, they are persistent, or surround the base of the fruit, and give it a complete covering, when ripe, they form what botanists call a cup (cupula,) as in the oak, &c.

The cup may be scaly, that is to say, composed of very close small scales, as in the oak (quer-cus robur.)

It may be foliaceous, that is to say, composed of small leaves, more or less free and distinct, as in the hazel (corylus avellana.)

Lastly, it may sometimes be pericarpoid, that is to say, composed of a single piece, completely covering and concealing the fruit, and sometimes opening regularly when ripe to permit its escape, as in the chesnut, the beech, &c.

When the involucre surrounds a single flower, is very close to it and resembles a calyx, it is called calycle or external calyx, as in the mallow, the marsh mallow. Flowers which have a calycle are said to be calycled (flores caliculati.)

The spathe is a membranous involucre, containing one or more flowers, which it completely covers before their expansion, and which never appear externally before it is unfolded or ruptured: for example, in the palms, the narcissus, the different species of allium, such as the common onion, &c.

The spathe is monophyllous, that is to say, composed of a single piece, as in the wake robin (arum maculatum;) composed of two pieces, or diphyllous, in the garlick, onion, &c.

It is hood-shaped (s. cucullata,) or convolute, in the arum.

Ruptile, that is to say, bursting irregularly in order to give exit to the flowers, as in the narcissus.

One flowered, two flowered, or many flowered, accordingly as it contains one, two, or a greater number of flowers.

Membranous, when it is thin and semitransparent, as in the narcissus, allium.

Woody, when it has the consistence and texture of wood; as in many of the palms: for example, the date palm (phœnix dactylifera,) &c.

Petaloid, when it is soft and coloured like a corolla; ex, richardia æthioipca, &c.

Sometimes the flowers contained in a spathe are each enveloped in a proper spathe, which bears the name of spathilla, as in most of the irideæ.

The grasses and cyperaceæ, which are so different from the other families of plants in their general aspect, and in the structure of their organs, have, properly speaking, neither calyx nor corolla. The parts which have received those names differ essentially fromthe same organs in the other phanerogamic vegetables. They are

only true involucres, possessing, however, a peculiar arrangement, which cannot be discovered in other vegetables; accordingly, they have received peculiar names.

Thus, in the grasses, the name of glume (gluma) is given to the two scales of various forms, which are nearest to the sexual organs. (See Pl. 6. fig. 15. b.b.) Sometimes these two scales are united into one, which is then bifid, as in alopecurus, the cornucopiæ. All the other scales, which are without the glume, constitute the lepicene (lepicena.) Their number is very variable. Thus there is but one in the agrostis canina L; two, in most of the other species of agrostis, cynodon, &c. (See Pl. 6. fig. 14. a.a.) External to the sexual organs we often find one or two small bodies of very variable forms. They bear the name of paleolæ, and together they constitute the glumella. (See Pl. 6. fig. 15. a.a.)

When in the grasses, two or a greater number of flowers are united so as to form a small spike, called spikelet (spicula,) or lodicle, the common integument is also called lepicene. It may be one valved as in the lolium, or two valved as in the poa, or many valved as in several species of uniola. From this it follows, that each little flower in particular is destitute of a proper lepicene, and is surrounded only with a glume, which, in this case, is always two valved. We then say

that the spikelet or lepicene is two flowered, three flowered, &c., according to the number of flowers they contain.

CHAPTER II.

OF THE INFLORESCENCE.

The name of inflorescence is given to the general disposition or mode of arrangement of the flowers on the stem, or on the organs that support them.

The flowers are said to be solitary, whenever they grow singly on different points of the stem, at greater or less distances from each other, for example, in the tulip, the hundred leaved rose.

They are terminal, when situated at the top of the stem, as in the tulip.

Lateral, when they grow on the sides of the stem or of the branches.

Axillary, when they grow in the axilla of the leaves, as in the periwinkle (vinca major,) in the ivy leaved speedwell (veronica hederæfolia,) &c.

Twin flowers (flores gemini,) are those which grow two together on the same point of the stem, as in the viola biflora.

Ternate flowers (flores ternati,) those which grow three together on the same point of the stem; for example, those of the teucrium flavum.

Fasciculated or in clusters (flores fasciculati,) when they issue more than three together from the same point of the stem, or of the branches, as in the cherry tree (cerasus communis.)

We must now examine the kinds of inflorescence which have received particular names.

When the flowers are disposed upon a common axis, which is simple or not ramified, whether the peduncle be erect or pendant, they form a spike (spica, flores spicati;) example, wheat, barley, rye, ribwort plaintain, black currant (ribes nigrum,) barberry (berberis vulgaris,) the orchis, &c.

The base of each flower is often accompanied with a scale or bractea, in which case the spike is said to be bracteated or scaly; for example, in the orchis militaris.

Sometimes the flowers are placed spirally around the rachis, as in the ophrys æstivalis and O. autumnalis (spiranthes, Rich.)

At other times the flowers are very close, the spike is short and globular (spica globosa,) as in the orchis globosa, several species of squill, &c.

If the common peduncle is often branched irregularly, this disposition takes the name of raceme (racemus, flores racemosi,) as in the vine.

The characters which most authors have given to distinguish the spike from the raceme are so uncertain, that it is almost impossible to distinguish those two modes of inflorescence. Thus, some have said, that, in the spike, the flowers are sessile, but peduncled in the raceme ;* others, that the recme is always pendulous and the spike erect. We think it useless to insist upon the little value of those characters. That which we have adopted appears to be more fixed, and, particularly, of easy application in practice, the axis of a spike is always simple ; that of a raceme is always branched.

When the common axis is erect, and the peduncles irregularly divided into pedicles, bearing the flowers, if the whole assemblage is of somewhat a pyramidal form, it takes the name of thyrse (thyrsus, flores thyrsoidei.) Such are the lilach (syringa vulgaris,) the privet (ligustrum vul-

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* This is the common acceptation of the term raceme, and the advantages of that which our author has proposed as a substitute, are not such as to warrant a deviation from the common usage ; for although, by adopting his definitions of spike and raceme, those two modes of inflorescence may be more easily distinguished, yet the difficulty will be increased of distinguishing the raceme from either the panicle or the thyrsus ; so that what is gained in precision on the one hand, will be lost on the other.—Trans.

gare,) the horse chesnut (æsculus hippocastanum.)

This species of inflorescence is hardly distinguishable from the raceme.

Flowers are said to form a panicle (flores paniculati,) when the common axis is ramified, and its secondary divisions are very long and distant from each other. This species of inflorescence belongs almost exclusively to the grasses; such, for instance, are the male flowers of the Indian corn (zea mais,) agrostis spica venti, the reed (arundo donax,) &c.

The flowers form a corymbus (flores corymbosi,) when the peduncles and pedicles all arise at different points from the upper part of the stem, but all are elevated, nearly to the same level, as may be observed in the common yarrow (achillæa millefolium.)

The cyme (cyma,) is that in which the peduncles arise from the same point, the pedicles being unequal, and proceeding from different points, but all raising their flowers to the same level, as may be observed in the elder (sambucus nigra,) the wild cornel (cornus sanguinea,) &c.

The flowers are said to form an umbel (flores umbellati,) when all the peduncles, which are equal to each other, proceed from the same point of the stem, diverge, ramify into pedicles, which also spring from a common point, so that the

whole of the flowers represents a protuberant surface, like an expanded parasol. This arrangement exists in the whole of that very natural family of plants, the umbelliferæ; such are the carrot (daucus carotta,) the hemlock (conium maculatum,) &c.

The whole of the peduncles united form an umbel; each group of pedicles constitutes a partial umbel.

At the base of the umbel there is often found an involucre, and at the base of the partial umbel an involucellum, as in the carrot. At other times there is no general involucre, but there are partial ones, as in the cow parsley (chærophyllum sativum.)

Lastly, the general and partial involucres may not exist at all, as in the pimpinella saxifraga, p. magna, &c.

The flowers form a sertulum, when the peduncles are simple, proceeding from the same point, and rising nearly to the same level, as in the flowering rush (butomus umbellatus,) most of the species of the genus allium, the cowslip, &c.

This species of inflorescence has been classed with the umbel, but it differs from it so widely as to deserve a particular name.

The flowers are in whorls or verticillated (flores verticillati,) when they form a ring round

a given point of the stem. Ex. the genus myriophyllum and hippuris vulgaris, &c.

In general, it is said that the labiatæ have flowers in whorls; but in this case we are imposed on by appearances. In fact, in all the plants of this family, the flowers are placed in the axillæ of the two opposite leaves, and supported upon divided peduncles, so that they grow only from two opposite points, instead of growing from the whole circumference of the stem.

The spadix is a kind of inflorescence, in which the common peduncle is covered with naked unisexual flowers, that is to say, without a proper calyx, and usually distinct and separated from each other, as in the arum maculatum, the calla palustris, &c. Sometimes, however, there are scales which separate the flowers, but they cannot be regarded as calyces, because they grow from the substance of the peduncle, of which they appear to be appendages, and are always situated beneath the point which gives attachment to the flowers, as in certain species of pepper.

The spadix is peculiar to monocotyledonous plants, and to some species of pepper. Sometimes it is naked, that is to say, without any integument to cover it, as in the peppers; at other times it is inveloped in a spathe, as in the aroideæ, and in certain species of palms.

The catkin (amentum, flores amentacei,) is

that in which unisexual flowers are inserted on scales, which seem to serve instead of peduncles; such are the male flowers of the walnut (juglans regia,) of the hazel (corylus avellana,) the male and female flowers of the willow. This species of inflorescence also occurs in an entire family of vegetables, composed of trees of greater or less altitude, which are called amentaceæ. Such are the willow, the poplars, the alders, the birch, the hornbeam, the oak, the beech, &c.

The names of capitulum, calathide or anthodium, are given to that mode of inflorescence, which the ancients called a compound flower. Of this we have examples in the thistles, the artichoke, the scorzonera, and in general, in all the plants of the family of the compositæ. The capitulum is formed of a more or less considerable number of small flowers, united together on a common receptacle, which is clearly more protuberant and larger than the top of the peduncle, of which, however, it is but the termination, and is called phoranthus. It is surrounded with a particular involucre, which formerly received the name of common calyx. Thus, for example, in the artichoke (cinara scolymus,) the green leaves whose bases are eaten, belong to the involucre; the lower, broad and fleshy part is the phoranthium or clinanthium. The flowers are in the centre of the leaflets of the involucre. They are

very small, and intermixed with stiff and erect bristles.

The phoranthium is variously modified. It is sometimes slightly concave, as in the artichoke; at other times very convex, prominent, and, as it were, cylindrical, as in some species of anthemis, rudbeckia, &c. In general it is smooth; sometimes, however, it has pits or depressions which contain the bases of the small flowers, as in the onopordum. Sometimes it is naked, that is to say, bearing nothing but flowers; at other times the flowers are accompanied with scales or hairs, which are more or less stiff and pointed.

The involucre is also very variable. Thus, it is sometimes composed of a single row of leaflets, as in the salsifies (tragopogon;) sometimes its scales are very numerous, imbricated, and forming several rows, as in the knapweed, the thistles, &c.*

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* A classification of the different modes of inflorescence on a principle which promises to introduce some degree of clearness and precision into a subject, that has been heretofore deficient in both, has been lately proposed by M. Ræper, a Professor of Botany at Bâle. He considers every species of inflorescence as belonging either to the centripetal evolution or to the centrifugal, or as being a compound of both. Of the centripetal evolution we have an example in the umbelliferæ and compositæ, such as the hemlock and the dandelion, in which the flowers of the circumference are expanded first, and those in

CHAPTER III.

ÆSTIVATION.

By the term æstivation (æstivatio, præfloratio,) is understood the arrangement of the different parts of a flower before its developement. According to this definition, it may be seen, that we

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the centre last. The term centripetal, or tending to the centre, is felicitously employed to express this mode of evolution. When the flowers are expanded in the opposite order, that is, when the central flowers open first, and the others in succession, according to their distance from the centre, the evolution is said to be centrifugal. In the examples adduced of the hemlock and dandelion, where the flowers are all nearly in the same horizontal plane, the meaning of those terms is perfectly obvious; but they may also be extended to those cases in which the flowers grow at different heights upon the branch or stem, by considering the summit as the centre, and the base as the circumference; for it is obvious, that if the pedicles of a raceme, for instance, were crowded near its summit, and the lower were a little prolonged, that the whole would assume the appearance of a simple umbel, and that the top of the raceme would be the centre of the umbel. Using the term in this extended meaning, Ræper includes in the centripetal evolution a great many modes of inflorescence. It contains the raceme, the amentum, the panicle, the simple and compound corymbiform raceme; that is, a raceme either simple or compound, whose lower peduncles or pedicles are so prolonged as

here include all the various positions which the different parts of the flower may assume in the bud.

This consideration has been too long neglected, and yet it deserves the greatest attention from botanists; for the æstivation is generally the same in all plants of the same natural family. Heretofore, the æstivation of the corolla alone has been attended to; but that of the calyx,

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to raise their flowers to the same level with those in the summit. It contains the umbel both simple and compound, the capitulum and its numerous modifications, including the compound and most of the aggregate flowers. The glomerulus, which has been heretofore considered as nearly allied to the capitulum, is, according to the new system, regarded as perfectly distinct from it, inasmuch as it belongs to the centrifugal evolution. This class of inflorescences is also called axillary, because each flower or peduncle grows in the axilla of a leaf; and indefinite, because the common axis of support is terminated by a leaf bud, and may, therefore, be prolonged indefinitely, if there be a due supply of nourishment. In the centrifugal evolution, on the contrary, each branch or peduncle is terminated by a flower bud, and cannot, therefore, be prolonged in that direction. To its lateral developement, however, there is no other limit than what arises from the scarcity of nourishment. The centrifugal inflorescence, for the above reason, is also called the terminated, in contra-distinction to the indefinite.

In this class of inflorescences, instead of one bracte or floral leaf, each terminal flower has two or more at its base.

and of the other sexual organs, possesses an equal degree of importance.

The petals or divisions of the corolla may be imbricated (petala imbricata, præfloratio imbricata,) when they cover each other laterally by a small portion of their width, as in the rose, apples, cherry, flax, &c.

The monopetalous corolla may be folded like a filter made of paper (corolla plicata, præfloratio

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From their axillæ spring two or more new branches around the flower which terminates the branch that supports them, and these again are terminated by a central flower and two or more lateral branches, having an equal number of bracteæ at their base. In this manner the process of bifurcation, trifurcation, &c. proceeds, until the supply of nutriment is exhausted. The term cyme is applied to the whole of this class of inflorescences. It includes the dichotomous cyme, of which we have many examples in the caryophylleæ, such as cucubalus, silene, the trichotomous, tetrachotomous, pentachotomous cymes, of which there are examples in the different species of euphorbia. Sometimes one of the lateral branches proves regularly abortive, in which case, the central flower appears to be lateral. The whole of the flowers in this case are unilateral, and the inflorescence has a circinal involution, as, for instance, in the echium, and the rest of the boragineæ. This is called a scorpioid cyme (cyma scorpioides.)

When the lateral branches are very short, and the flowers crowded together, as in the sweet William, the inflorescence is called fasciculus or contracted cyme. When the peduncles are so short as to be scarcely distinguishable, they constitute the

plicativa,) as in the convolvulaceæ, in several solaneæ.

The petals or the divisions of the monopetalous corolla, are sometimes rolled spirally (petala spiraliter contorta, præfloratio torsiva,) as in the oxalis, the apocineæ, &c.

The petals are often corrugated or rumpled (petala corrugata, præfloratio corrugativa,) that is to say, folded in every direction, as in the poppies, the pomgranates, the cistus, &c.

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glomerulus, which is distinguished from the capitulum only by its mode of evolution.

In all these cases, the central flower which terminates each branch, is expanded before those on the lateral branches that spring beneath it, and the evolution is, therefore, said to be centrifugal.

The figure of the cyme may resemble that of a corymbus or of an umbel, in which case it is called corymbiform or umbelliform cyme.

The mixt or compound inflorescences are of two kinds, the thyrsus and the corymbus. When the central axis belongs to the indefinite inflorescence and the lateral branches to the terminated, it constitutes a thyrsus. When, on the contrary, the central axis is developed according to the laws of the terminated inflorescence, and the branches according to those of the indefinite, it forms the true corymbus.

Of the thyrsus we have examples in the labiatæ, whose inflorescence has been heretofore considered as a series of whirls, but which is now more properly regarded as consisting of a number of cymes growing in the axillæ of the leaves. There

The petals may touch one another by their edges, like the valves of a capsule (præfloratio valvaris,) as in the araliaceæ for instance.

When there are five petals, of which two are internal and two external, and the remainder covers the internal with one of its edges, and has the other edge covered by the external, M. De Candolle has given the æstivation the name of quincuncial; for example, in the pink.

These different modifications are equally applicable to the calyx.

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may be various modifications of the thyrsus, such as the paniculiform, spiciform, racemiform, &c.

With respect to the term corymbus, as its meaning includes the new idea of a particular mode of evolution, it must be more restricted in its application than formerly. Still, however, it applies to many of those inflorescences which it denoted before. Several of the syngenesious plants have all the characters necessary to constitute a corymbus, according to its new signification. Thus, for instance, the achillæa millefolium (yarrow,) has several peduncles, each bearing a compound flower, springing at different heights from the stem, and all rising to the same level. This was sufficient to constitute a corymbus according to its old acceptation. But, moreover, each individual capitulum or compound flower pursues the centripetal evolution, while the central capitulum with those around it, expands before those in the circumference. Since, therefore, it combines the two modes of evolution, the centripetal in its parts, and the centrifugal in the whole, it possesses the characters of the corymbus according to its new signification.

In the umbelliferæ and urticeæ, the stamina are bent inwards towards the centre of the flower; they become erect, and sometimes they are even bent outwards after its expansion.

CHAPTER IV.

OF THE FLORAL INTEGUMENTS IN GENERAL.

We have already seen that the floral integuments are not essential parts of the flower, because many plants are wholly destitute of them. Accordingly, we shall not be surprised to see flowers, in which the calyx and corolla are both wanting, and which yet are replaced by perfect fruits.

Linnæus gave the general name of perianth (perianthium,) to the whole of the floral integuments which surround the sexual organs.

The perianth is simple or double.

When simple, it receives the name of calyx, whatever may be its colour, consistence, or form, as in the tulip, the lily, the thymeleæ, &c.

All the monocotyledonous plants have no corolla; their perianth is always simple, and therefore a calyx.

When the perianth is double, the inner inte-

gument, that is to say, the one next to the sexual organs, takes the name of corolla; the outer is called calyx. It has been also said, that the calyx is continuous with the bark of the peduncle, the corolla with the corpus ligneum, or with the part situated between the pith and the bark in annuals. But this assertion is not well founded.

Such is the opinion generally received by those authors who cultivate the natural affinities of plants; and, in fact, it appears in most cases to be conformable to nature. Here, however, it is proper to remark in regard to the monocotyledons, that in many cases, particularly when the perianth is composed of distinct segments, we might admit the existence of two integuments around the sexual organs. In fact, the six pieces, which compose the simple perianth of the greater number of monocotyledons, are usually disposed as it were in two rows, so that three of them appear to be internal and three external. If to this we add that the three inner are often coloured and petaloid, while the three outer are green and resemble a calyx, we can see reason for admitting in these plants the existence of a double perianth, that is to say, of a calyx and a corolla. This arrangement is particularly remarkable in the virginian spiderwort (tradescantia virginiaca.) Its simple perianth has six divisions, of which the three inner are larger, thin, delicate, and of a

beautiful blue colour; the three outer are smaller, green, and perfectly different from the others. It is the same in the alisma plantago, sagittaria, &c., which have the three inner divisions of their perianth coloured and petaloid, while the three outer are green and resemble a calyx. These exceptions, however, are only apparent, and disappear on a closer examination. For although the six segments of the perianth of a great many monocotyledons are disposed in two rows, they yet form at the top of the peduncle that supports them but a single circle; that is to say, they have a common point of origin, and are all six clearly continuous with the outer part of the peduncle. They, therefore, constitute but one and the same organ, namely, the calyx. In fact, if they formed two distinct integuments, a calyx and a corolla, the point of origin of the corolla should be within that of the calyx, as being continuous with the woody substance of the stem, or the part that represents it, while the calyx is a continuation of the epidermis or of the outer part of the peduncle. From all these considerations we may conclude, that monocotyledons never have a corolla, but simply a calyx, whatever may be the colour and arrangement of the parts that compose it.

The vast and interesting family of the orchideæ, which differs so widely from the other monocotyledonous plants, in the form and outer appear-

ance of its flowers, as well as in their internal structure, also possesses a simple perianth of six divisions, but with peculiar modifications, which it will be necessary here to notice. Of these six divisions, three are internal, and three external to the former. The three outer with two of the inner, are very often united together at the upper part of the flower, and form by their close approximation a species of arch or helmet, which covers and protects the sexual organs. Hence the calyx is said to be helmet shaped (galeatus.) Of the three inner divisions, one is in the middle and lower than the other two, from which it usually differs both in form and colour. It has received the peculiar name of labellum. This is the part which, in a great many species, presents such varied and extraordinary forms. Sometimes it seems to resemble an humble bee reposing on the plant (ophrys apifera,) sometimes a spider (ophrys aranifera,) at other times an ape whose lower parts are spread out. In several genera of this family the labellum has, at its lower part, a hollow process, like a horn, which has received the name of spur (calcar.) In this case it is said to be spurred (labellum calcaratum.) The presence, absence, or relative length of the spur, serves as a distinctive character of certain genera of the orchideæ.

The floral integuments, notwithstanding the

delicacy of their texture, and the varied colours with which they are frequently embellished, are, in general, but leaves, which are slightly modified. In the calyx, in particular, this analogy, or rather this identity of structure, is very striking. In fact, there are some flowers, in which the sepals or leaflets of the calyx, have so strong a resemblance to the leaves, that it is difficult not to admit them to be one and the same organ. Yet, in order to facilitate the establishment of the generic characters of plants, botanists have agreed to consider organs as perfectly distinct from each other, which are identically the same.

We shall now examine separately the two floral integuments which compose the double perianth, namely, the calyx and corolla.

CHAPTER V.

OF THE CALYX.

The calyx is the outer covering of the perianth, or it is the perianth itself, when it is simple.

It is composed of a variable number of leaves, forming the external verticil of the flower. These are sometimes perfectly distinct from each other, and sometimes more or less united.

It is easy to prove from analogy, that the simple perianth is a calyx and not a corolla, as Linnæus has often called it.

In fact, it is a general principle, admitted by all botanists, that the ovary is inferior (ovarium inferum) when it is united with or adheres to the tube of the calyx by every point of its circumference. Now the ovary is inferior in a great many monocotyledons which have but a simple perianth, such as the irideæ, the narcissi, the orchideæ, &c. From this we are, therefore, warranted to conclude, that the single integument, which is wholly united by its base with the ovary, is a true calyx.

The calyx is monosepalous whenever (calyx monosepalus,) whenever it consists of a single piece, or, more properly speaking, whenever the calycine leaves are all united together, as in the thorn apple and all the other solaneæ; in the sage and all the labiatæ. (See Pl. 5. fig. 1, 2. 3.)

M. De Candolle proposes to substitute the term gamosepalous calyx, for that of monosepalous; the first denoting that the calyx is composed of several united sepals, and not of a single sepal, as is expressed by the second.

It is polysepalous (calyx polysepalus,) when it is composed of a more or less considerable number of distinct pieces, which may be separated from each other without tearing their substance,

and which have received the name of sepals, as in the wall flower, the water cresses, &c.

Whenever the calyx is incorporated with the ovary, or which is the same, whenever the ovary is inferior, the calyx is naturally monosepalous.

The monosepalous calyx is almost always persistent after fecundation. It very often accompanies the fruit until it becomes ripe. Sometimes it even continues to grow in proportion as the fruit advances to maturity, as may be observed in the winter cherry (physalis alkakengi,) &c.

The polysepalous calyx is generally caducous; it very often falls after fecundation, sometimes even as soon as the flower is expanded, as in the poppies.

In the monosepalous calyx are distinguished, 1°, the tube or the lower part, which is usually long and narrow; 2°, the border (limbus,) or upper part, which is more or less open and spreading; 3°, the throat (faux,) or the line which separates the tubus from the limbus.

The limb of the monosepalous calyx may be more or less deeply divided. Thus, it is simply toothed (calyx dentatus,) when it has sharp teeth. It may be three toothed (c. tridentatus,) as in the widow wail (cneorum tricoccum,) four toothed (c. quadridentatus,) as in the privet, the lilach. (See Pl. 5. fig. 1.) Five toothed (c. quinquedentatus,) as in a great many of the labiatæ, of the caryo-

phylleæ, &c. These teeth may themselves be variously modified. Thus they are equal or unequal, erect, spreading, or reflexed. The meanings of these terms are so obvious as require no definition.

The monosepalous calyx may be cleft (c. fissus,) when the incisions reach nearly to one half the entire depth of the calyx. Hence it is said to be:

Bifid (c. bifidus,) as in the marsh louse wort (pedicularis palustris.)

Trifid (c. trifidus.)

Quadrifid (c. quadrifidus,) as in the rhinanthus crista galli.

Quinquefid (c. quinquefidus,) as in the henbane (hypocyamus niger,) in tobacco. (See Pl. 5. fig. 2.)

Multifid (c. multifidus,) &c.

When the divisions are very deep, and reach nearly to its base, the calyx is then said to be:

Bipartite (c. bipartitus,) as in the genus orobanche.

Tripartite (c. tripartitus,) as in the anona triloba.

Quadripartite (c. quadripartitus,) as in the veronica officinalis.

Quinquepartite (c. quinquepartitus,) as in borage (borago officinalis,) in the purple fox-glove (digitalis purpurea,) &c.

Multipartite (c. multipartitus,) &c.

Lastly, in opposition to all these terms, the calyx is said to be entire (calyx integer,) when its border has neither teeth nor incisions; for example, in many of the umbelliferous genera.

The monosepalous calyx may be regular or irregular.

It is regular (c. regularis,) when all its divisions are perfectly equal, whatever may be their figure or form; for example, that of borage, of the pink, &c.

On the contrary, it is irregular (c. irregularis,) when the corresponding divisions have neither the same size nor figure, as in the nasturtium or Indian cress.

With respect to form, the calyx is tubular (c. tubulosus,) when it is narrow, very long, and has not a spreading border, as in the cowslip (primula veris,) the pink. (See Pl. 5. fig. 10.)

Turbinated (c. turbinatus,) having the form of a pear or of a top; for example, in the berry bearing alder.

Urceolated (c. urceolatus, ventricosus,) swelled at the base, contracted at the throat, the border being expanded, as in the genus rosa, the henbane.

Inflated or vesicular (inflatus, vesiculosus,) when it is thin, membranous, dilated like a bladder, and much larger than the base of the corolla

which it surrounds, as in the cucubalus behen, the rhinanthus crista galli, &c.

Campanulate or bell shaped (c. campanulatus,) growing wider from the base towards the orifice which is very open, as in the common bastard balm (melittis melissophyllum.)

Cup shaped (cupuliformis,) flattened or slightly concave, as in the lemon tree (citrus medica.)

Cylindrical (c. cylindricus,) when from its base to its upper part it forms a tube, all whose diameters are nearly equal, as in the pink. (See Pl. 5. fig. 10.)

Club shaped (clavatus, claviformis,) when the tube is slightly swelled at its top, as in the silene armeria.

Compressed (c. compressus,) broad and flattened laterally, as in the marsh lousewort (pedicularis palustris.)

Prismatic (c. prismaticus,) having well marked sides and angles, as in the lung wort (pulmonaria officinalis.)

Angulose (c. angulosus,) having a great number of longitudinal angles.

Furrowed (sulcatus,) having longitudinal grooves.

Two lipped (c. bilabiatus,) having its divisions so arranged as to present an upper and an under lip, separated from each other; for ex-

ample, in the sage (salvia officinalis,) and in a great number of other labiate plants.

Spurred (c. calcaratus,) having a hollow prolongation at its base, as in the nasturtium.

Two winged (c. dipterus,) having two lateral and membranous appendages similar to wings.

Three winged (tripterus,) having three lateral membranous appendages in the form of wings.

The calyx has often very vivid colours, particularly when there is no corolla, as in the daphne mezereon, the narcissus, orchideæ, &c.

It is important to attend to the proportions of the calyx and corolla. Thus, in general, the calyx is shorter than the corolla, (calyx corollâ brevior.) At other times it is longer (calyx corolla longior,) as in the cockle (agrostemma githago.)

Lastly, it may be equal to the corolla (calyx corollæ æqualis.)

The calyx may be free from all adhesion, or it may be wholly or partially united and incorporated with the ovary. In this case, the calyx is said to be adherent (calyx ovario adhærens,) and the ovary is necessarily inferior.

The polysepalous calyx may be composed of a more or less considerable number of sepals or distinct pieces. Thus it is :

Disepalous (c. disepalus,) when it is composed

of two sepals, as in the poppy (papaver somniferum,) in the fumitory (fumaria officinalis.)

Trisepalous (c. trisepalus,) composed of three sepals, as in the pile wort (ficaria ranunculoides.)

Tetrasepalous (c. tetrasepalus,) having four sepals, as in the cabbage, the water cress, and other cruciferæ. (See Pl. 5. fig. 9.)

Pentasepalous (pentasepalus,) when it has five sepals, as that of flax (linum usitatissimum,) &c.

The figure and form of sepals ought to be studied, as well as that of leaves or of the divisions of a monosepalous calyx. Thus, they may be lanceolate, acute, obtuse, cordiform, &c.

The polysepalous calyx may also have different forms, depending on the relative position of its sepals. Thus it is tubular (c. tubularis,) when the sepals are long, erect, and approximated, so as to form a tube. Many of the cruciferæ are of this description. (See Pl. 5. fig. 9.)

It may be campanular (c. campanularis.)

Starlike (stellaris,) when it is composed of five sepals, which are equal and spreading, as in many of the caryophylleæ.

CHAPTER IV.

OF THE COROLLA.

The corolla never exists but when the perianth is double; it is its inner integument. It

immediately surrounds the organs of reproduction, and although continuous with the woody part of the stem, it has a soft and delicate texture. Being painted with the richest colours, it chiefly attracts the notice of the vulgar, who can never see a flower, where there is not a large and brilliant corolla. The botanist, on the contrary, considers this organ as only an accessory part of the flower; while a stamen or a pistil, which is sometimes scarcely visible, constitutes a true flower.

The corolla may be monopetalous or gamopetalous (c. monopetala, gamopetala,) that is to say, all whose different pieces are united into a single whole, as in the digitalis purpurea, the bind weed (convolvulus arvensis,) the deadly night-shade (atropa belladonna.) (See Pl. 5. fig. 1, 2, 3, 4.)

It may be composed of a more or less considerable number of distinct segments, which are called petals (petala.) In this case, it is called polypetalous (c. polypetala,) as in the rose, the pink, the wall flower. (See Pl. 5. fig. 9, 10, 11.)

Every petal presents for our consideration, first the unguis (claw,) or lower narrow part, by which it is attached; secondly, the lamina or broad part of various forms which surmounts the unguis.

The figure of the petals is exceedingly various, and, in general, may be referred to the different modifications which we have described as belong-

ing to the leaves; thus, some of them are round, others oblong, acute, obtuse, toothed, entire, &c.

Like the calyx, the corolla may be either regular or irregular.

It is regular whenever its incisions or divisions are equal to each other, or its parts are disposed regularly round a common axis. For example, that of the rampion bell flower (campanula rapunculus,) of the wall flower (cheiranthus cheiri. (See Pl. 5. fig. 1, 2, 3, 9.)

On the other hand it is irregular, when its incisions are unequal, or the parts that compose it do not appear to be placed regularly round a common imaginary axis, as in the snap dragon (antirrhinum majus,) the greater hooded milfoil (utricularia vulgaris,) the nasturtium (tropæolum majus.) (See Pl. 5. fig. 7, 8, 12.)

The monopetalous corolla falls off in a single piece when it withers. Sometimes its base is persistent, as in the marvel of Peru (nyctago hortensis.)

In the polypetalous corolla, on the contrary, each of the petals falls separately. Yet it may happen that in a polypetalous corolla, all the segments or petals will fall together, being connected at their base, as in the mallow (malva rotundifolia,) the marsh mallow (althæa officinalis,) &c. In this case the corolla is nevertheless polypetalous; but the petals are accidentally united at

their base by an expansion of the substance that forms the stamina and filaments. We could give several other examples of the same kind.

A monopetalous corolla is said to be spurred (c. calcarata,) when it has a hollow prolongation at its base resembling a horn, as in the toad flax (antirrhinum linaria.) (See Pl. 5. fig. 7.)

The monopetalous corolla presents three parts for consideration; an inferior part, which is usually cylindrical and tubular, being more or less elongated, and is called tube (tubus;) a part superior to the tube, which is more or less hollow, sometimes spreading and even reflexed, and receives the name of limb (limbus.)

Lastly, the circular line which separates the tube from the limb takes the name of throat (faux, palatum.) The study of these parts is of the utmost importance, inasmuch as their various forms and relative dimensions furnish the botanist with characters, by which he may distinguish certain genera of vegetables. (See Pl. 5. fig. 1, 2, &c.)

In general, the monopetalous corolla gives origin to the stamina.

We shall pass in review the different modifications of the monopetalous and polypetalous corollas, when they are either regular or irregular.

§ 1. *The Monopetalous regular Corolla.*

The monopetalous regular corolla has a great diversity of forms.

Thus it is tubular (tubulata,) when its base is very long, as in the marvel of Peru (nyctago hortensis,) the lilach (syringa vulgaris.) (See Pl. 5. fig. 1, 2.)

The tube is sometimes capillary or filiform as in certain syngenesious flowers.

The corolla is bell-shaped or campanulate (corolla campanulata,) when it has no distinct tube, but gradually widens from the base to the upper part, as in the rampion (campanula rapunculus,) the great bind weed (convolvulus sepium,) jalap (convolvulus jalapa,) &c. (See Pl. 5. fig. 3.)

It is funnel-shaped (c. infundibuliformis,) when the tube is first narrow at its lower part, and afterwards gradually widens, so as to have a campanulate border. For example, the tobacco (nicotiana tabacum,) &c. (See Pl. 5. fig. 2.)

It is said to be salver shaped (cor. hypocrateriformis,) when its tube is long, narrow, and not widened at its upper part, with a flat spreading border, so as to have the shape of an ancient cup, as the lilach (syringa vulgaris,) the jasmin (jasminum officinale.) (See Pl. 5. fig. 1.)

The corolla is rotate or wheel shaped (cor. rotata,) when the tube is very short and the limb spreading and nearly flat, as in the borage (borage officinalis,) and in most species of solanum.

The corolla is said to be stellated (cor. stel-

lata,) when it is very small, its tube very short, and the divisions of its border sharp-pointed and elongated. For example, in the different species of galium (bed straw,) of asperula (woodruff,) &c.

It is urceolated (cor. urceolata,) when swelled like a small pitcher at its base, contracted near its orifice, as in many of the heaths, in vaccinium, &c. (See Pl. 5. fig. 4.)

It is saucer shaped (cor. scutellata, scutelliformis,) when it is spreading and slightly concave.

§ 2. *Monopetalous irregular Corolla.*

The monopetalous irregular corolla is said to be bilabiate (cor. bilabiata,) when the tube is more or less lengthened, the throat open and expanded, the border divided transversely into two portions, the one upper, the other lower, which have been compared to the parted lips of an animal. This form of corolla particularly characterizes an entire family of plants, one of the most natural in the vegetable kingdom, namely the labiatæ. (See Pl. 5. fig. 8;) for example, thyme (thymus vulgaris,) balm (melissa officinalis,) sage (salvia officinalis,) rosemary (rosmarinus officinalis,) &c.

These two lips may have various modifications, on which are founded the characters that distinguish the genera belonging to this family. Thus

the upper lip is sometimes flat, sometimes arched, erect, falciform, &c. It may be entire or without incisions, emarginate, bidentate, two-lobed, bifid, &c.

The under lip is usually reflexed. Sometimes it is concave and folded on its edges, as in the genus nepeta. It may be also trifid, three lobed, or tripartite.

Sometimes the upper lip seems not to exist, or at least is so little developed, as to be very indistinct, as in the genera teucrium and ajuga.

The personate corolla (corolla personata,) is that whose tube is more or less lengthened, whose throat is expanded and closed above by the approximation of the lips, which are unequal, so as to be a coarse representation of the muzzle of an animal or of certain ancient masks. Such are those of the snap dragon (antirrhinum majus,) of the toad flax, &c. (See Pl. 5. fig. 7.)

Lastly, under the name of anomalous irregular monopetalous corollas are united all those, which differ widely from every type that we have established, and cannot be referred to any of them. Thus, the corolla of the purple fox-glove (digitalis purpurea,) which nearly resembles the finger of a glove, the corollas of the hooded milfoil (utricularia,) the butter wort (pinguicula,) &c. are at once irregular and anomalous.

In the different forms of regular and irregular

monopetalous corollas which we have now examined, the three parts which compose them, namely, the tube, the throat, and the border, have various modifications, which it is useful to be acquainted with.

Thus the tube may be:

Cylindrical (cylindricus,) as in the lilach (syringa vulgaris,) the marvel of Peru (nyctago hortensis, &c. (See Pl. 5. fig. 1.)

It may be long or short relatively to the calyx or to the border.

Ventricose or inflated (ventricosus, inflatus,) either in its under part or towards its summit. In this case it is said to be:

Club shaped (claviformis,) as in the spigelia marilandica.

Lastly, it may be smooth, striated, angular, prismatic, &c. We have already repeatedly explained the meanings of these terms.

The throat may be:

Closed (clausa,) when it is completely shut, as in the snap dragon (antirrhinum majus.)

Open and dilated (aperta, patens,) as in the purple fox-glove, in certain labiatæ, &c.

It may be furnished with hairs, as in marjarom, thyme, &c.

Ciliated (ciliated,) having lashes as in the gentiana amarella, &c.

Crowned with projecting appendages of va-

rious forms, as in the borage (borago officinalis,) the comfrey (symphytum consolida,) buglos (anchusa italica,) and many other borragineæ.

Lastly, in opposition to the foregoing terms, it is said to be naked, when it has neither hairs nor protuberance, nor appendages.

The limb or part of the corolla that surmounts the throat may be :

Erect (erectus,) as in the hounds-tongue (cynoglossum officinale.)

Spreading, open (patens,) when it forms a right angle with the tube, as in the rose bay (nerium oleander.)

Reflexed or bent outwards (reflexus,) like that of dulcamara, of the cranberry (vaccinum oxycoccos,) &c.

The limb may be also more or less deeply incised. Thus, it is sometimes simply toothed on its edge.

It is also trifid, quadrifid, or quadripartite, quinquepartite, according to the depth of the incisions.

The form of the different divisions of an incised limb has a great many varieties, which may be referred to those of the petals, and of the leaves.

We may here remark, in concluding what relates to the monopetalous corolla, that its form is not an important character in the arrangement of

genera into natural families. In fact, many different forms are found united in groups which are exceedingly natural. Thus, in the solaneæ are found rotate corollas, such as those of verbascum, of solanum; funnel shaped corollas (tobacco,) hypocrateriform corollas, as in some species of cestrum; and campanulate corollas, as in the hyocyamus and belladonna. We might institute a similar comparison in many other families which are equally natural.

The Polypetalous Corolla.

The number of petals varies exceedingly in the different polypetalous corollas. Thus, there are corollas composed of two petals, as in the enchanter's night shade (circæa lutetiana.) In this case it is called dipetalous (cor. dipetala.)

Tripetalous (cor. tripetala,) composed of three petals, as that of the widow wail (cneorum tricoccum,) &c.

Tetrapetalous (cor. tetrapetala,) composed of four petals. For example, all the cruciferæ, such as the water cress (nasturtium officinale,) the horse radish (cochlearia armoracia,) the broad leaved pepper-wort (lepidium latifolium,) &c. (See Pl. 5. fig. 9.)

Pentapetalous (cor. pentapetala,) composed of five petals, as all the umbelliferæ, the rosaceæ;

for example, the parsnip (pastinaca sativa,) common parsley (apium petroselinum,) hemlock (conium maculatum,) the strawberry. (See Pl. 5. fig. 10, 11.)

Hexapetalous (cor. hexapetala,) having six petals, as the barberry (berberis communis, &c.

The petals or divisions of a polypetalous corolla may be clawed, that is, furnished with a very evident claw, as in the pink, the wall flower. (See Pl. 5. fig. 9. a.)

Or else they may be sessile, that is to say, destitute of a claw, as in the vine (vitis vinifera,) gypsophila muralis, &c.

The length of the claw and its proportion to the calyx deserves our consideration. Thus, the claw is often shorter than the calyx (unguis calyce brevior;) at other times, on the contrary, it is longer than it, and projects from it (unguis calyce longior.)

The petals are often erect (petala erecta,) that is to say, they take a direction parallel to the axis of the flower, as geum rivale.

They are sometimes inflexed (petala inflexa,) or curved towards the centre of the flower, as in many of the umbelliferæ.

Spreading (petala patentia,) as in the strawberry (fragaria vesca,) the herb bennet (geum urbanum, &c. (See Pl. 5. fig. 11.)

Reflexed (pet. reflexa,) turned outwards.

The figure of the petals is extremely variable. Its principal modifications may be referred to those already established for the leaves and the sepals. Yet they sometimes have singular forms, which we shall now briefly consider.

The petals are concave (pet. concava,) in the lime tree (tilia europæa,) the rue (ruta graveolens,) &c.

Helmet shaped (petala galeiformia,) when they are arched, hollow, and resemble a helmet, as in the monkshood (aconitum napellus,) &c.

Hood shaped (pet. cuculliformia,) having the form of a hood, or of a paper coffin, as in the columbine (aquilegia vulgaris,) in the larkspur (delphinium consolida.)

Spurred (pet. calcarata,) having a spur at their base, as in the violet, the larkspur.

The polypetalous corolla may be regular or irregular, accordingly as the parts that compose it are disposed symmetrically or not around the axis of the flower. In either case, the petals, by their form, number, and relative situations, give to the corolla a peculiar form and aspect, which serve to divide it into several groups.

§ *The regular Polypetalous Corolla.*

The regular polypetalous corolla has three principal modifications. It may be:

Cruciform (cor. cruciformis,) composed of four petals with claws, disposed in the form of a cross. The plants whose corolla has this form constitute one of the most natural families in the vegetable kingdom. They have received the name of cruciferæ. Such are the cabbage, the wall flower, the water cress, &c. (See Pl. 5. fig. 9.)

The four petals of a cruciform corolla are not always equal and similar to each other; some of them are often smaller or larger. Thus in the genus iberis, two petals are always larger.

Rosaceous (cor. rosacea,) that which is composed of three to five petals, rarely of a greater number, having a very short unguis, and spreading out in the same plane. Such are all the rosaceæ, as, for instance, the common rose, the almond, the apricot, the plum tree, &c., the celandine and plants of other families. (See Pl. 5. fig. 11.)

Caryophyllaceous (cor. cryophyllata,) a corolla composed of five petals, whose ungues are very long, and concealed by the calyx, which is also long and erect, as in the pink, silene, cucubalus, &c. (See Pl. 5. fig. 10.)

§ *Irregular Polypetalous Corolla.*

The papilionaceous (cor. papilionacea.) This corolla is composed of five very irregular petals,

which have each a peculiar form, and are, therefore, designated by particular terms. Of the five petals, one is superior, two are lateral, and two inferior. The upper bears the name of standard (vexillum.) (See Pl. 5. fig. 12. a.) It is usually erect, of a very variable figure, and covers the other four, before the expansion of the flower. The two lower, which are usually connected and coherent by their under edges, form the keel (carina,) (fig. 12. c.) The two lateral ones constitute the wings. (Alæ) (fig. 12. b. b.)

A fancied resemblance between this corolla and a butterfly with expanded wings, has procured for it the name of papilionaceous. The truly papilionaceous corolla belongs to the vast family of the leguminosæ : such are the pea (pisum,) the kidney bean (phaseolus,) the acacia (robinia pseudacacia,) the milk vetch, &c.

A corolla which is composed of irregular petals, but cannot be referred to the papilionaceous, receives the name of anomalous, (cor. anomala.) Such are those of the monkshood, of the larkspur, of the violet, of the balsams, of the nasturtium, &c.

The positions of the petals or of the divisions of a monopetalous corolla, with respect to the sepals or to the divisions of the calyx, presents the two following modifications:

The petals may be opposite to the divisions of the calyx, that is to say, so situated as to mutually coincide by their surfaces, as in the barberry (berberis vulgaris,) epimedium alpinum, &c.

They may be alternate with the divisions of the calyx, that is to say, opposite to its incisions and not to its segments. This arrangement is much more common than the former, which is very rare. The petals are alternate with the sepals in the cruciferæ, &c. &c.

The relative magnitudes of the corolla and of the calyx, also deserves particular notice; for they very often furnish excellent distinctive characters.

According to its duration, the corolla is fugacious or caducous (caduca, fugax,) when it falls as soon as it opens, as in the papaver argemone, in several cisti, &c.

Deciduous (c. decidua,) falling after fecundation. Most corollas are of this class.

Marcescent (c. marcescens,) remaining after fecundation, and withering on the flower, before it is detached from it, as in the heaths and in certain cucurbitaceæ.

The corolla is usually the brightest part of the flower. The delicacy of its texture, the brilliancy and freshness of its colours, and the sweet perfume which is often exhaled by it, render it one of the most agreeable productions of nature.

Its office, as well as that of the calyx, appears to be to protect the sexual organs before their perfect developement, and to favour, at fecundation, the mutual action of those organs upon each other.

CHAPTER VII.

OF THE SEXUAL ORGANS.

THE discovery of sexual organs in vegetables does not ascend to a very remote period. Down to the sixteenth century, the flowers which grow upon vegetables were regarded as nothing but ornaments, with which nature thought proper to decorate them. At that period, Camerarius and Grew demonstrated by experiments the utility of the different parts of the flower, in the production of the seed, and in the preservation of the species. They shewed that the pistil, which occupies the centre of the flower, is analogous, both as to structure and particularly as to functions, to the female organs of reproduction in animals. In fact, it contains the imperfect rudiments of the embryo (ovules;) a cavity, destined to contain and protect them during their developement (ovary;) a particular organ fit to receive

the fecundating influence of the male (stigma;) another organ whose office it is to transmit this influence to the embryos (style.) They also proved that the stamen ought to be considered as analogous to those organs which are the attribute of the male in animals; for it contains in a particular cavity (anther,) a peculiar substance (pollen,) whose office is to fecundate the ovules. It was then established that vegetables as well as animals are provided with sexual organs, destined for their reproduction. The stamen constitutes the male sexual organ; the female sexual organ is the pistil.

In almost all vegetables, both the organs of reproduction are united in the same flower, which is, therefore, called hermaphrodite. In others, on the contrary, there is but one of the two sexual organs, and the flower is said to be unisexual.

The unisexual flower may be either male or female, accordingly as it contains stamens or a pistil.

Male and female flowers are sometimes united on the same plant, in which case it is said to be monœcious. The chesnut tree (castanea vulgaris,) and the hazel (corylus avellana,) are examples of it.

At other times, the male and female flowers are separated and placed on two distinct vegetables. The plants, in this case, are said to be

diœcious. Such are the annual mercury, the paper mulberry (broussonetia papyrifera,) the date palm (phœnix dactylifera.)

Lastly, there are sometimes found mixed together upon the same or upon different vegetables, male flowers, female flowers, and hermaphrodite flowers. Vegetables which have the three species of flowers disposed in this irregular manner have received the name of polygamous. Such are pellitory of the wall (parietaria officinalis,) crosswort (galium cruciatum,) &c.

These three divisions founded on the union, separation, and mixture of the sexes, have served Linnæus as a basis for the establishment of the three last classes of the phanerogamic plants of his system; namely, monœcia diœcia, polygamia.

CHAPTER VIII.

OF THE STAMEN OR MALE SEXUAL ORGAN.

The stamen performs in vegetables an office precisely similar to that of the male organs in animals, that is, it contains the substance by which the germs are fecundated.

The stamen is usually composed of three

parts: of the anther (anthera,) a species of small membranous bag, whose inner cavity is double, that is, consisting of two cells united together; of the pollen (pollen,) a substance usually composed of very small vesicular grains, which contain the fluid necessary for fecundation; of the filament (filamentum,) a small filiform appendage which often supports the anther.

Such are the three parts that usually compose the stamen. But we may here remark, that only two of these are necessary, the anther and the pollen. In fact, the filament is only an accessory part of the stamen, and accordingly it is often wanting, that is, the anther is immediately attached to the part which gives it insertion without the intervention of a filament. In this case the stamen is said to be sessile (stamen sessile,) as in many of the thymeleæ.

The essence and perfection of the stamen reside, therefore, in the anther. But a condition indispensably necessary, in order that this organ may perform the office intrusted to it by nature, is, that it should not only contain pollen, but moreover, that it should open, in order to bring that substance in contact with the stigma; for without it, fecundation cannot be effected.

The number of stamina varies exceedingly in the different plants; so much is this the case, that Linnæus founded the first classes of his system on

the consideration of the number of stamina contained in each flower.

Thus, there are flowers which have but a single stamen; these are called monandrous flowers (flores monandri.) Such are the hippuris vulgaris, the red valerian, the blitum virgatum, &c.

Diandrous flowers (flores diandri,) are those which contain two stamina. For example, the lilach (syringa vulgaris,) the privet (ligustrum vulgare,) the common speedwell (veronica officinalis,) the sage (salvia officinalis,) &c.

Triandrous flowers (flores triandri,) most of the grasses, of the cyperaceæ, of the irideæ, &c.

Tetrandrous flowers (flores tetrandri,) yellow bedstraw (galium verum,) madder (rubia tinctorum,) most of the labiatæ, of the antirrhinums, of the dipsaceæ, &c.

Pentandrous flowers (flores pentandri:) the great mullein (verbascum thapsus,) and most of the solaneæ; the hound's tongue (cynoglossum officinale,) and most of the boragineæ; the carrot (daucus carrota,) and all the umbelliferæ, &c.

Hexandrous flowers (flores hexandri,) the lily (lilium candidum,) the tulip (tulipa gesneriana,) and most of the liliaceæ, of the asphodeleæ, the rice (oryza sativa.)

Heptandrous flowers (flores heptandri,) the horse chesnut (æsculus hippocastanum.)

Octandrous flowers (flores octandri,) those of the heaths, of the vaccinium, of the daphne, of the polygonum, &c.

Enneandrous flowers (flores enneandri,) those of the flowering rush (butomus umbellatus.)

Decandrous flowers (flores decandri,) as in the pink, the soapwort (saponaria officinalis,) and the greater part of the caryophylleæ; the rue (ruta graveolens,) the winter green (pyrola rotundifolia,) the saxifrage, &c.

Beyond ten, the number of stamina contained in flowers is not fixed; thus they they are said to be:

Dodecandrous (flores dodecandri,) when they contain from twelve to twenty stamina, as in the dyer's weed (reseda luteola,) in agrimony (agrimonia eupatoria.)

Polyandrous (flores polyandri,) when they contain more than twenty stamina, as the poppy, (papaver somniferum,) the ranunculus, &c.

The stamina may be all equal to each other, as in the lily, the tulip, &c.

They may be unequal, that is to say, some longer and others shorter in the same flower.

Sometimes this disproportion is symmetrical; sometimes it exists without any order or regularity. In the geranium and the oxalis, there are ten stamina, five large and five smaller, so arranged as to have a large one between each two

of the smaller stamina, and *vice versâ*. When a flower contains four stamina, of which two are always shorter, these stamina take the name of didynamous (stamina didynama :) most of the labiatæ, horehound (marubium vulgare,) thyme, &c. most of the antirrhinums, such as common toad flax (antirrhinum linaria,) the snap dragon (antirrhinum majus,) have their stamina didynamous.

When, again, there are six stamina in each flower, and that four of them are always longer than the other two, they are called tetradynamous (stamina tetradynama.) This arrangement exists in the entire family of the cruciferæ, as in the scurvy grass (cochlearia officinalis,) the radish, &c.

The situation of the stamina in respect to the divisions of the corolla and of the calyx, also deserves to be carefully attended to. In general, each stamen corresponds with the incisions of the corolla ; or, in other words, the stamina are alternate with the divisions of the corolla or with the petals, when they are of an equal number with those divisions, as in the borage and in the rest of boragineæ.

Sometimes, however, the stamina, instead of being opposite to the incisions, correspond with the lobes or with the petals. In this case the

stamina are said to be opposite to the petals, as may be observed in the cowslip, in the vine, &c.

When the number of stamina is double the divisions of the corolla, one half of the stamina is alternate with the divisions of the corolla, the other half is opposite to them. In most cases, the stamina are opposite to the divisions of the calyx, or to the sepals, except in those rare cases, where they are opposite to the petals.

In the lily and tulip, the stamina are opposite to the six segments of the simple perianth.

Sometimes the stamina are shorter than the corolla or the calyx, so as not to project beyond it. They are then said to be enclosed (stamina inclusa,) as in the cowslip, the narcissus, the daphne, &c.

On the contrary, they are said to be projecting (stamina exerta,) when they appear above the edge of the corolla or of the calyx, as in the european box thorn (lycium europæum,) the mint, the plantain, &c.

According to their direction the stamina are:

Erect (stam. erecta,) as in the tulip, the lily, the tobacco, &c.

Inflexed (stamina inflexa,) when they have the figure of an arch, and their summit is curved towards the centre of the flower, as in the sage, in the white fraxinella (dictamnus albus.)

Reflexed (stamina reflexa,) when they are

curved outwards, as in the pellitory of the wall (parietaria officinalis,) the paper mulberry (broussonetia papyfera,) &c.

Spreading (stamina patentia,) when they spread out horizontally, as in the ivy (hedera helix.)

Pendulous (stamina pendentia,) when their filament is very slender, and too feeble to support the anther, as in most of the grasses.

Ascending (stamina ascendentia,) when they are all directed towards the upper part of the flower, as in the sage.

Declining (stamina declinata, decumbentia,) when they are all bent downwards to the lower part of the flower, as in the horse chesnut (æsculus hippocastanum,) the fraxinella, &c.

The stamina are sometimes united by their filaments, or by their anthers; at other times they are united, and as it were embodied with the pistil. We shall speak of these different modifications, when treating separately of the filament and anther.

In some flowers there is observed a certain number of stamina, which are always abortive. In general, these stamina are replaced by appendages which have received the name of staminodia, as in the virginian spiderwort (tradescantia virginica,) most of the orchideæ, &c.

One stamen is always abortive in the antirrhinum and in many of the personate flowers;

two in the sage, the lycopus, the rosemary, &c. and in all the diandrous labiatæ, as well as in all the orchideæ, with the exception of the cypripedium; three in the bignonia, the hedge hyssop; five in the erodium, &c.

§ 1. *Of the Filament.*

The filament, as we have already observed, is not an essential part of the stamen; for, very often, it is wholly wanting. Most usually its form corresponds with its name, that is, it is elongated, narrow, and filiform.

It is flat (fil. planum, compressum,) in the allium fragrans, the periwinkle, &c.

Wedge-shaped (fil. cuneiforme,) having the form of a wedge, in the thalictrum petaloideum.

Awl-shaped (fil. subulatum,) or having the form of an awl, when it is long, and becomes gradually smaller towards the top, as in the tulip, &c.

Capillary (fil. capillare,) when it is slender like a hair; for example, in the wheat, in the barley, and in most of the grasses.

Petaloid (f. petaloideum,) when it is broad, thin, and coloured like a petal, as in the nymphæa alba, the scitamineæ, &c.

Sometimes it is expanded at the base, as in the ornithogalum pyrenaïcum.

At other times it is, as it were, arched (fil. basi fornicatum,) as in the asphodel, the bell flower, &c.

The top of the filament is usually pointed, as in the tulip, the lily, &c.

At other times it is obtuse, and even swelled into a head or capitulated, as in the cephalotus, &c.

In most cases, the anther is attached to the top of the filament. Sometimes, however, it happens to be prolonged beyond the insertion of that organ. In this case it is said to be prominent (fil. prominens,) as in the paris quadrifolia, &c.

The stamina are usually free from adhesion, and separated from each other; but it sometimes happens that they are united by their filaments into one or more bundles, which, with Mirbel, we shall call androphorum.

When all the filaments are united into one androphorum, the stamina take the name of monadelphous (stamina monadelpha,) as in the mallow, the marsh mallow, &c. (See Pl. 6. fig. 10.)

In this case the androphorum forms a tube, which is more or less complete. Sometimes, however, the filaments are united only at their base, so as to have their greater portion free, as in the geranium, the erodium.

At other times they are united to one half their length, as in many species of oxalis. (See Pl. 6. fig. 10.)

Lastly, they are united into a nearly complete tube in most of the malvaceæ. At its upper part, the tubular androphorum is divided into as many small, short, and distinct filaments, as there are anthers.

When all the stamina are united into two androphora, that is, when their filaments unite into two distinct bundles, they are called diadelphous, (stamina diadelpha.) For example, the fumitory (fumaria officinalis,) the kidney bean, the acacia, &c. and the greater part of the leguminosæ. (See Pl. 6. fig. 11.)

When the filaments are united into three or more androphora, the stamina are said to be polyadelphous (stamina polyadelpha.) There are three androphora in the hypericum ægyptiacum, five and more in the melaleuca.

The organic nature and structure of the filaments of stamina appear to be exactly the same with those of the corolla. In fact, we very often see one of these organs changed into the other. Thus, for example, in the white water lily (nymphœa alba) the filaments of the stamina are seen to become successively broader and thinner from the centre to the circumference, while at the same time the anther diminishes, and at last dis-

appears, when the filament is completely changed into a petal. It was this insensible change of the filaments of stamina into petals, that led some botanists to suppose that the corolla, and the segments that compose it, were only abortive stamina, whose filaments had acquired an extraordinary developement. This opinion, which we are not inclined either fully to admit or altogether to reject, seems to derive support from the formation of double flowers. The rose, for instance, in its original wild state, has only five petals, but a great number of stamina. In our gardens, by the cares of the cultivator, we see the stamina of the rose changed into petals, and the flower become barren. In this instance, the conversion of the filaments into petals is manifest, and appears to confirm the opinion of the botanists who regard the corolla as true abortive stamina.

§ 2. *Of the Anther.*

The anther (anthera,) is that essential part of the stamen which contains the pollen or fertilizing dust before the act of fecundation.

In general it is composed of two small membranous bags, immediately applied to each other by their sides. (See Pl. 6. fig. 6, 7, 8,) or united by the intervention of a peculiar body, which

has received the name of connectivum. (Pl. 6. fig. 9. a.)

Each of these small membranous bags called cells, is divided internally into two parts by a longitudinal partition, and opens at fecundation to let out the pollen. The anthers, therefore, are usually two-celled (antheræ biloculares,) as in the lily, the hyacinth. Sometimes they consist of only one cell, in which case they are said to be unilocular (antheræ uniloculares,) as in the coniferæ, the epacrideæ, the malvaceæ, the hazel, &c.

More rarely still the anther is composed of four cells, and is called quadrilocular (anthera quadrilocularis,) as in the butomus umbellatus, &c.

Each cell of an anther has usually upon one of its surfaces a longitudinal groove, by which, in most cases, it opens. The side of the anther which is marked with these grooves, is, properly speaking, the front; that which is opposite to it, and by which the anther is attached to the filament is the back.

The anther is usually fixed on the top of the filament by its base, as in the iris, the gladiolus; it then bears the name of basifixed (anthera basifixa.)

It may be fixed by the middle point of its back, as in the lily. In this case it is called mediifixed (anthera mediifixa.)

It is very often attached by its summit; in this case it is mobile and vacillating. It is then called apicifixed (anthera apicifixa.)

When the front of the anthers is turned towards the centre of the flower, they are said to be introrse (antheræ introrsæ,) as is the case in most vegetables; on the contrary, they are called extrorse (antheræ extrorsæ,) when their front is turned to the circumference of the flower, as, for example, in the irideæ, the cucumber. This disposition is more rare than the former.

The form of the anthers presents a great many varieties. Thus, they are said to be:

Spheroidal (antheræ spheroïdales, subglobosæ,) when they approach the rounded form, like those of the mercury (mercurialis annua.)

Twin (antheræ didymæ,) having two spheroïdal lobes, united by a point of their circumference, as in the spinage (spinacia oleracea,) the spurges, &c.

Ovoïdal (antheræ ovoïdeæ,) this form is one of the most frequent.

Oblong (antheræ oblongæ,) as in the lily (lilium candidum,) &c.

Linear (antheræ lineares,) when they are very long and narrow, like those of the campanula and of the magnolia.

Sagittate (antheræ sagittatæ) or arrow headed:

for example, those of the rose bay (nerium oleander,) of the crocus, &c.

Cordiform (antheræ cordiformes,) as in the sweet basil (ocymum basilicum,) &c.

Reniform (antheræ reniformes,) or kidney shaped; in the purple fox-glove (digitalis purpurea,) a great many mimosæ.

Tetragonal (antheræ tetragonæ,) having the form of a four sided prism like those of the tulip (tulipa gesneriana.)

At its summit, the anther may be terminated in various ways: thus it is:

Acute (anthera apice acuta,) in the borage (borago officinalis.)

Bifid (anthera bifida,) cleft at its summit, or at its base, into two narrow distant lobes, as in a great many of the grasses.

Two-horned (bicornes,) terminated at the top by two long horns, as in the whortle berry (vaccinium myrtillus,) the winter green (pyrola rotundifolia.

Appendiculated (antheræ appendiculatæ,) crowned with appendages of very various forms, as in the elicampane (inula helenium,) the rose bay (nerium oleander.)

The two cells which form the anther may be connected together in different ways. They may be united immediately without the intervention of

any other body, as in the grasses. (See Pl. 6. fig. 6, 7, 8.)

Of this species of union, there are two different modifications. Thus, they are sometimes united by their sides, so as to have their grooves in the same surface and lying parallel. In this case the cells are said to be apposited (loculis appositis,) as in the lily.

At other times, on the contrary, they are united by the surfaces opposite to the grooves, so as that the grooves shall be at opposite sides of the anther. The two cells are then said to be opposite (loculis oppositis.)

This disposition, however, is less frequent than the former. They may be united immediately by the upper part of the filament, which is prolonged between them, as in a great many species of ranunculus.

Lastly, they may be more or less distant from each other by the interposition of another body, which is clearly distinct from the top of the filament. This body has received the name of connectivum, as it serves as a means of union between the two cells. (See Pl. 6. fig. 9. a.)

The connective is sometimes visible only at the back of the anther; in that case it is called dorsal, as may be observed in the lily, &c.

At other times it may be seen on both surfaces, and clearly separates the two cells of the

anther, as in the melissa grandiflora, the Virginian spider wort. (See Pl. 6. fig. 9.)

Lastly, it sometimes happens that the connective is so large and so overgrown, as to be recognised only by analogy. In this case it has received the name of distractile connective.

Thus, for example, in the sage the connective has the form of an oblong curved filament, placed in a transverse direction on the top of the true filament. At one end of it is seen one of the cells of the anther full of pollen; at the opposite end is the other cell, but nearly always abortive, and in the rudimental state.

This singular conformation is also found in the melastomeæ, and in several species of the labiatæ and of the scrophularineæ.

The cells of an anther may open in different ways in different genera of vegetables, and the characters taken from this circumstance serve, in some instances, to distinguish certain genera.

In general, the dehiscence takes place by the suture which runs along the groove on the surface of each cell. In this case, the cells are said to be longitudinally dehiscent, as in the lily, the tulip, and a great many other plants. The dehiscence may take place by pores or slits, in different parts of the anther.

Thus, in the erica and the solanum, each cell

opens by a small pore at its summit (loculi apice dehiscentes.) (See Pl. 6. fig. 7. a. a.)

In the winter-green this pore is situated at the lower part (loculi basi dehiscentes.)

At other times, a species of small valves open from the under towards the upper part, as in the laurels, the barberry, the epimedium alpinum, &c. (See Pl. 6. fig. 8.)

We have, heretofore, considered the anthers as free from cohesion; but these, as well as the filaments, may approximate and cohere, so as to form a kind of tube. This remarkable disposition is met with in the vast family of the compositæ, such as the thistle, the artichoke, the marigold, &c. Linnæus gave the name of syngenesia to that class of his system which contains the plants whose anthers are united laterally; and the anthers he called syngesious. (See Pl. 6. fig. 13.)

In a great many plants, the stamina, instead of being free, or simply united by their filaments or anthers, are incorporated with the pistil, that is, they intimately adhere to the style and stigma. These plants have received the name of gynandrous. (See Pl. 6. fig. 14.)

The stamina never coalesce with the ovary. The filaments and the style alone become united, so as that the anthers and the stigma are borne by a common support, with which they form one

body. This is what may be observed in the aristolochiæ, the orchideæ, &c.

In the orchideæ, the name of gynostemium is given to the common support of the stigma and anthers.

§ 3. *Of the Pollen.*

The pollen, or the substance contained in the cells of the anther, and which is necessary for fecundation, has usually the appearance of a dust composed of small grains of extreme minuteness. Sometimes it exists in solid masses of considerable magnitude. This latter form being restricted to a small number of vegetables, will not be considered until we have first examined the structure of that pollen which exists under the form of powder.

Before optical instruments were brought to any perfection, our knowledge of the various forms of the grains of pollen, and particularly of their internal structure, was extremely uncertain. A great diversity had been noticed in those that were examined with strong magnifiers; but their differences were merely remarked without drawing from them any conclusions that might be favourable to the advancement of science. The structure of the grains of pollen had also been a subject of inquiry with most of the old botanists;

but for want of means of accurate observations, they were engaged in endless disputations respecting the internal structure of these elementary bodies. The microscopical examination of the pollen was, therefore, a subject worthy of revision, and could not fail to engage the attention of modern observers. M. Amici, of whom we have already had occasion to make honourable mention in this Work, has published, in the Acts of the Italian Society, vol. xvii., a chapter on the pollen, in which he makes known some very interesting facts that shall be mentioned below. In the course of the year 1824, our friend M. Guillemin, with the aid of M. Selligue's achromatic microscope, made numerous observations on the pollen, of which we shall here communicate the principal results.

The grains of pollen are small bags of various forms, which have no connexion with the anther at the period of maturity, and contain a multitude of granules of extreme minuteness.

The membrane which constitutes these cavities is at one time smooth, at other times marked with small eminences or asperities. Sometimes it exhibits minute surfaces or projections, which are arranged symmetrically with respect to each other. When the pollen has a perfectly smooth surface, it is never at the same time covered with a viscid coating, whereas the slightest eminences

are indications of viscosity. The papillæ or mammillary eminences, which cover certain grains of pollen, are true secreting organs, and the viscid and usually coloured coating that covers them is the product of those organs. The powdery pollens may, therefore, be reduced to two principal classes, namely, into those that are viscid and those that are not. Considerations taken from the general form are of far less value; in other words there is less difference between those that are spherical, elliptical, polyedral, &c., than between such as have and have not a viscid integument.

From a great number of observations, M. Guillemin is satisfied, that the nature of the grains of pollen is the same in each natural family of plants, or in other words, that in any of those families we do not at the same time meet with the viscid pollen and with that which is not viscid. He also observed, that all the genera of the same family exhibit only different modifications of form in their grains of pollen; but that families very remote from each other in most of their characters, agree with each other in the identity of their pollens. We shall be satisfied with describing the nature and form of this organ in a few remarkable families only.

The pollen of the malvaceæ and of the convolvulaceæ is composed of spherical papillary

grains, of a silvery white colour. In the cucurbitaceæ, they are spherical, papillary, and of a beautiful golden yellow. Those of the helianthus tribe among the compositæ, are also spherical, papillary, and of a beautiful orange yellow. The tribe, or rather the order of chicoraceæ, presents us with viscid spherical grains, whose surface is cut into minute surfaces. The cobæa scandens has a pollen whose grains are covered with mammillary eminences, each of which is surmounted with a brilliant point. That of the phlox is very similar to the latter, a circumstance which favours the opinion of those who consider these two genera as belonging to the same family.

Lastly, in order to conclude this enumeration of viscid pollens, the grains of the onagrarieæ have a form which is manifestly triangular, with a considerable depression in their centre.

The families which have grains that are not viscid are very numerous. It will be sufficient to mention the solaneæ, scrophularineæ, gentianeæ, caryophylleæ, gramineæ, euphorbiaceæ, &c. These grains have always an elliptical form, and are marked with a longitudinal groove. In general, they are of a yellow colour; but sometimes they are red, as in the verbascum. In the papilionaceous leguminous plants, the pollen is not viscid; but its grain is of a very marked cylindrical form.

When grains of pollen which are not viscid are exposed to the action of water, they instantly change their form ; from elliptical, they become perfectly spherical. The viscid grains are first stripped of their coverings, and then they more or less suddenly burst, and scatter around a liquid, which is denser than water, in which myriads of small grains are moving, that are rendered visible by their greenish colour, when magnified to several hundred times their diameter. M. Amici has seen a grain of pollen belonging to the portulaca oleracea, in contact with a hair of the stigma, to burst and to protrude a kind of bowel, in which the granules circulated for more than four hours. Gleichen, who had already observed the granules in the seeds of pollen, had considered them as performing the principal part in the act of fecundation; and M. Guillemin, reasoning from the analogy of these organs to the spermatic animalcules of animals, is inclined to adopt the same opinion.

Such was the knowledge we possessed of the nature and organization of the grains of pollen, when our friend M. Adolphus Brongniart undertook his beautiful work on Generation in Vegetables. We shall here make known his opinion respecting the nature and organization of the grains of pollen. On examining the interior of the cells of a young anther in the flower bud,

long before its expansion, it is observed to be filled with a mass of cellular tissue, distinct from its parietes. By degrees, each of the cells, of which the entire mass is composed, and which are generally very small, is separated from the others, and ultimately forms a granule, which is called pollen. Sometimes these distinct cells or grains of pollen are contained within other larger vesicles, which burst, and of which some traces are still visible.

Each grain of pollen, whose form, as we have already seen, is exceedingly variable, has an uniform organization. It is composed of two membranes, an outer, which is thicker, furnished with pores and sometimes with appendages that are more or less elevated, and an inner, which is thin, transparent, and unconnected with the former. When exposed to the action of water, the inner swells, and the outer bursts at some point of its surface, and through the opening there issues a tubular prolongation, which forms a kind of hernia, and which was first observed by Needham. M. Amici has also seen it on the pollen of the portulaca pilosa. Sometimes there are two ruptures at two opposite points, as in the œnothera biennis. The cavity of the inner membrane is full of spherical granules of extreme minuteness, which appear to perform the most important part in the act of fecundation.

We shall now speak of the pollen, of the asclepiadeæ, and of the orchideæ, which exhibit very remarkable modifications. In several genera of both these families, the whole of the pollen contained in one cell is united into a body, which has the form of the cells that contain it. To this pollen, thus united, is given the name of massa pollinica. When these masses are divided into other smaller ones, the latter receive the name of massulæ. The masses of pollen in the orchideæ are sometimes composed of solid grains, united together by a kind of elastic net work; they are then called massæ sectiles, as in the genera orchis, and ophrys. At other times they are quite granular or farinaceous (massæ granulosæ.) Such are those of the genus epipactis, loroglossum, &c. Lastly, they sometimes form a compact and solid substance, as in the genera corallorhiza, malaxis. These three forms never occur united or mixed together in the same genus. When pollen is thrown upon red hot coals, it inflames and burns rapidly. In many plants it exhales an odour which has the most striking resemblance to that of the substance to which it has been compared in animals, as, for instance, in the horse chesnut, the barberry, &c. When the pollen begins to be developed, that is to say, long before the expansion of the flower, it appears under the form of a cellular mass, which is sometimes covered with

a very thin proper membrane, that has no connexion with the cavity which contains it. The small cells composing this mass are, at first, intimately united to each other; within them are observed a few scattered granules. By degrees the cells begin to separate, their granules become united, and, in a short time, by successive developement, they burst the bags that contain them, acquire their proper form, and ultimately become grains of pollen. We may see that this mode of developement is perfectly similar to that of the cellular substance, which was described in treating of the elementary tissues of vegetables.

CHAPTER IX.

OF THE PISTIL, OR FEMALE SEXUAL ORGAN.

We have already seen that the pistil is the female sexual organ of vegetables. It almost invariably occupies the centre of the flower, and is composed of three parts, the ovary, the style, and the stigma.

In general, there is but one pistil in each flower, as in the lily, the hyacinth, the poppy, &c. Sometimes, however, there are several in the same flower, as in the rose, the ranunculus,

&c. The pistil, or the pistils when there are many of them, are often attached to a peculiar prolongation of the receptacle, which has received the name of gynophorum.

We must be careful not to confound the gynophorum with the podogynum, a contraction of the base of the ovary, which raises the pistil a little above the bottom of the flower. The gynophorum, in fact, does not essentially belong to the pistil, for it remains at the bottom of the flower when the pistil is detached from it. The podogynum, on the contrary, which forms a part of the pistil, accompanies it in all the periods of its developement. The strawberry and raspberry have a gynophorum; the caper and the poppy a podogynum.

When the flower contains many pistils, it is not unusual for the gynophorum to become thick and fleshy. This is very evident in the raspberry, and particularly in the strawberry. The pulpy saccharine part of the strawberry which is eaten, is nothing but the highly developed gynophorum; the small shining grains that cover it are so many pistils. It is easy to distinguish the nature of these different parts, and to pursue their successive developements in the flower. The base of the pistil is always represented by its point of attachment to the receptacle. On the other hand, its summit is the point where either the style or

stigma are inserted on the ovary. As this insertion is sometimes lateral, it is obvious that its organic and geometrical summits do not always coincide. The geometrical summit is the highest point through which a line passes, which runs from the base through the centre of the ovary.

§ 1. *Of the Ovary.*

The ovary (ovarium,) always occupies the lower part of the pistil. Its essential character is to present, when cut either in the transverse or longitudinal direction, one or more cavities called cells, which contain the rudiments of the seeds or the ovules. It is within the ovary that the ovules become fully developed and are changed into seeds. This organ therefore, in respect to its functions, may be considered as analogous to the ovary and to the uterus in animals. The most general form of the ovary is the ovate; yet it is more or less compressed and elongated in certain families of plants, as in the cruciferæ, the leguminosæ, &c.

The ovary is generally free at the bottom of the flower; that is to say, its base together with those of the stamina and floral integuments, corresponds to the top of the receptacle without its forming any adhesion with the calyx, as may be

seen in the hyacinth, the lily, the tulip, &c. (See Pl. 6. fig. 1, 3.)

But sometimes the ovary cannot be seen in the bottom of the flower; it seems to be placed completely below the origin of the other parts; that is to say, being united in all points of its circumference with the tube of the calyx, its summit alone is free in the bottom of the flower. In this case the ovary is said to be adherent or inferior (ovarium inferum,) to distinguish it from the free ovary, which is called superior (ovarium superum;) the iris, narcissus, myrtle, and gooseberry, have an inferior ovary. (See Pl. 6. fig. 4.)

When, therefore, the ovary cannot be seen in the bottom of the flower, whose centre is occupied by a style and stigma, it will be necessary to examine if below the bottom there be not a particular swelling distinct from the top of the peduncle. If a transverse section of this swelling exhibit one or more cavities, containing ovules, we may be certain that there is an inferior ovary.

The situation of the ovary as inferior or superior, furnishes the most valuable characters for the grouping of genera into natural families.

Whenever the ovary is inferior, the calyx is necessarily monosepalous, because its tube is intimately united with the circumference of the ovary.

Sometimes the ovary is not wholly inferior,

that is, it is free by its upper third, one half or two-thirds. The genus saxifraga furnishes examples of these different degrees of adhesion.

There is one position of the ovary, which, although always confounded with the inferior, yet deserves to be distinguished from it. It is that wherein several pistils being united in the same flower, are attached to the inner wall of a calyx, which is greatly contracted at its upper part, so as at first to have the appearance of an inferior ovary. These ovaries receive the name of parietal (ovaria parietalia,) as in the rose and a great many other rosaceæ. (See Pl. 6. fig. 2.)

We must also describe a modification of the ovary, which has received the name of gynobasic ovary; a great many families furnish examples of it; such, among others, are the labiatæ, the boragineæ, the ochnaceæ, the simaroubeæ, &c. The ovary, applied to an hypogynous disc, which, in this case, has received the name of gynobasis, is more or less deeply divided into a number of lobes corresponding with that of the cells, and its central axis is so depressed, that it appears not to exist, and that the style seems to spring immediately from the disc; so that when ripe, each of the parts or cells that compose the ovary is separated, and seems, as it were, to be a distinct fruit.

The inferior ovary being that which adheres

to the tube of the calyx in all the points of its circumference, there flows from it a general law which has not been sufficiently attended to; namely, that the inferior position of the ovary necessarily excludes a multiplicity of pistils in the same flower. In fact, in the case of parietal ovaries, it may be seen that they are in contact with the calyx only at a single point; it is quite impossible that the calyx should embrace the whole of them at all points of their circumference. From this it follows that these ovaries are not inferior, but only parietal, inasmuch as they are not united with the tube of the calyx at all points of their circumference. This modification deserves particular notice.

The ovary is sessile in the bottom of the flower (ovarium sessile,) when it is not elevated upon any particular support, as in the lily, the hyacinth. (See Pl. 6. fig. 1, 3.)

It may be stipitate (ovarium stipitatum,) when it is borne upon a very long podogynum, as in the caper tree (caparis spinosa.)

A transverse section of the ovary frequently exhibits but a single internal cavity or cell, containing the ovules. It is then said to be one celled (ovarium uniloculare,) as that of the almond, the cherry, the pink, &c.

It is called two celled (ovarium biloculare,)

when it is composed of two cells, as in the lilach, the toad flax, the fox-glove, &c.

Three celled (ovarium triloculare;) such are those of the lily, the iris, the tulip, &c. (See Pl. 6. fig. 9.)

Four celled (ovarium quadriloculare,) as in the sagina procumbens.

Five celled (ovarium quinqueloculare,) as in the ivy (hedera helix.)

Many celled (ovarium multiloculare,) when it has a great number of cells, as the water lily.

But each cell may contain a variable number of ovules. Thus, some cells never contain more than one; they are then called uniovulate (locula uniovulata,) as in the grasses, the compositæ, the labiatæ, the umbelliferæ, &c.

At other times each cell contains two ovules, and is called biovulate (locula biovulata.) In cases where each cell of an ovary contains two ovules only, it is very important to study their relative positions. Thus, sometimes the ovules grow from the same point, and at the same height; in this case they are said to be apposited (ovulis appositis,) as in the euphorbiaceæ. At other times, on the contrary, they grow one above the other; they are then said to be superposed (ovulis superpositis,) as in the tamus communis.

On the other hand, they are said to be alter-

nate (ovulis alternis) when the points of attachment of the ovules are not in the same plane, although the ovules touch one another laterally: for example, the apple, the pear, &c.

In speaking of the seed, we shall return more in detail to the different positions of ovules with respect to each other, and with respect to the ovary.

Lastly, it sometimes happens that each cell of an ovary contains a very considerable number of ovules, as in the tobacco, the poppy, &c.; but these ovules may be disposed in different ways. They are very often placed regularly one above the other in a longitudinal direction, as in the birthwort (aristolochia sypho;) they are then called uniseriated (ovulis uniseriatis.) At other times they are disposed in two longitudinal lines: they are then biseriated (ovulis beseriatis,) as in the iris, the lily, the tulip, &c.

Sometimes they are scattered without any order, as in the thorn apple. At other times they are conglobated, or united and pressed together so as to form a globe, as in many of the caryophylleæ.

The fecundated ovules become seeds; but it frequently happens that a certain number of ovules proves regularly abortive in the fruit. Sometimes even several partitions are destroyed and disappear. It is, therefore, necessary to investi-

gate in the ovary, the true structure of the fruit. It is by this means only that certain genera can be placed near each other in the series of natural orders, which at first view differ widely in the structure of their fruits and in the disposition of their seeds.

§ 2. *Of the Style.*

The style is that filiform prolongation from the top of the ovary, which supports the stigma. (See Pl. 6. fig. 1, 3.)

Sometimes it is wholly wanting, in which case the stigma is sessile, as in the poppy, the tulip, &c.

The ovary may be surmounted by a single style, as in the lily, the leguminosæ; by two styles, as in the umbelliferæ; by three styles, as in the wayfaring tree (viburnum lantana,) &c. The ovary has four styles in the parnassia, five in the statice, linum, &c.

In other cases, on the contrary, there is but a single style for several ovaries, as in the apocyneæ, &c.

The style almost always occupies the highest point, that is to say, the geometrical summit of the ovary, as in the cruciferæ, the liliaceæ, &c. The style is then called terminal (stylus terminalis.)

It is called lateral, when it springs from the

lateral parts of the ovary, as in most of the rosaceæ, daphne, &c. It then shews the organic summit of the ovary, which, in this case, differs from the geometrical.

In some very few cases, the style appears to grow from the base of the ovary. It then takes the name of basilary style (stylus basilaris,) as in the ladies mantle (alchemilla vulgaris,) the bread tree (artocarpus incisa.)

Sometimes even, the style, instead of growing from the ovary, seems to spring from the receptacle, as in the labiatæ, in certain boragineæ, &c. This happens whenever the fruit is gynobasic; (see page 319.)

The style may be enclosed (stylus inclusus,) that is to say, contained within the flower, so as to be invisible externally, as in the lilach (syringa vulgaris,) the jasmin (jasminum officinale,) &c.

The style may project beyond the corolla (stylus exsertus,) as in the red valerian (valeriana rubra.)

The forms of the style are as numerous as those of the other organs, which we have formerly studied. In fact, although, in general, it is slender and filiform, yet in some vegetables, it presents an appearance which is altogether different. Thus it is triangular (stylus trigonus,) in the ornithogalum luteum, the lilium bulbiferum, &c.

It is club-shaped (stylus claviformis,) in the leucoium æstivum.

It is hollow (stylus fistulosus,) in the white lily (lilium candidum.)

Petaloid (stylus petaloideus,) broad, thin, membranous, and coloured like petals, as in the iris, &c.

According to its direction compared with the ovary, it is vertical in the lily.

Ascending (stylus ascendens,) forming an arch whose convexity is turned towards the top of the flower, as in the sage, and many other labiatæ.

Declined (stylus declinatus,) when it bends towards the lower part of the flower, as in the white fraxinella (dictamnus albus,) certain labiatæ and leguminous plants.*

The style may be simple (stylus simplex) and without any division, as in the periwinkles, the lily.

It is bifid in the red gooseberry (ribes rubrum,) trifid in the red corn flag (gladiolus communis,) quinquefid in the hibiscus, multifid in the mallow, accordingly as it is divided into two, three, five, or a greater number of divisions of little depth.

* Very often the stamina and pistils are declined in the same flower; in that case the sexual organs are said to be declined (genitalia declinata,) as in the fraxinella.

If, on the contrary, these divisions are very deep, and reach below its middle, it is said in that case to be bipartite, as in the rough gooseberry (ribes grossularia.) (See Pl. 6. fig. 4.) tripartite, quinquepartite, multipartite, &c., according to the number of its divisions.

The style seems to be sometimes connected with the top of the ovary by a kind of joint, so as to fall off after fecundation; it then takes the name of caducous (stylus caducus.) In this case a trace of it cannot be seen on the ovary, as in the cherry, the plum, &c. At other times, on the contrary, it is persistent (stylus persistens,) when it survives fecundation. Thus in the cruciferæ, the box, the anemones, the clematis, &c. the style is persistent, and becomes a part of the fruit.

Lastly, it sometimes is not only persistent, but even increases after fecundation, as in the pasque flower, the clematis, the avens, &c.

§ 3. *Of the Stigma.*

The stigma is that part of the pistil which is usually glandular, placed at the top of the ovary or of the style, and which is destined to receive the influence of the fecundating substance. Its surface is generally unequal, and more or less viscid.

Considered anatomically, the stigma is composed of elongated vesicles, converging from the surface of the stigma towards the style, and loosely connected together by a mucilaginous substance. The sevesicles are generally naked, rarely, they are covered by a very thin and transparent membrane.

The number of stigmas is determined by that of the styles, and of the divisions of the style. In fact, there are always as many stigmas as there are distinct styles or manifest divisions of the style.

The stigma is sessile, that is to say, immediately attached to the top of the ovary, when the style is wanting, as in the poppy, the tulip.

There is but one stigma in the cruciferæ, the leguminosæ, the primulaceæ, &c.

There are two in the umbelliferæ and a great many of the grasses.

There are three in the irideæ, the silene, the rhubarb, the rumex, &c.

There are five in the flax; six, and even a greater number in many other plants, such as the mallow.

In general, the stigma is terminal (stigma terminale,) that is to say, placed at the top of the style or of the ovary, as in the lily, the poppy, &c. (See Pl. 6. fig. 1, 3.)

It is lateral (stigma laterale,) when it occupies

the sides of the style, or of the ovary, if there be no style, as in the ranunculaceæ, the plane tree, &c.

According to the substance which forms it, it is fleshy (stigma carnosum,) when it is thick, fleshy, and succulent, as that of the lily.

Glandular (stigma glandulare,) when it is evidently composed of small glands, which are more or less approximated.

Membranous (stigma membranaceum,) when it is flat and thin.

Petaloid, when it is thin, membranous, and coloured like petals, as in the iris, &c.

According to its form, the stigma may be globular or capitate (globulosum, capitatum,) rounded into the shape of a little head; the cowslip (primula veris,) the deadly night-shade (atropa belladonna,) the marvel of Peru (nyctago hortensis.)

Hemispherical (stigma hemisphericum,) having the form of an hemisphere, as in the henbane (hyocyamus aureus.)

Discoid (stigma discoïdeum,) flat, broad, and resembling a buckler, as in the white poppy, the common red poppy, &c.

Club-shaped (stigma clavatum,) in the jasione montana, &c.

Capillary or filiform (stigma capillare, filiforme,) slender and very long, as in the Indian corn.

Linear (stigma lineare,) long and narrow, as in the campanula and many of the caryophylleæ.

Trigonal (stigma trigonum,) having the shape of a three-sided prism, as in the wild tulip (tulipa sylvestris.)

Three lobed (stigma trilobum,) composed of three rounded lobes, as in the lily. (See Pl. 6. fig. 1.)

Stellated (stigma stellatum,) flat, and cut into lobes like a star, as in the ericineæ, the pyrola, &c.

Umbilicated (stigma umbilicatum,) having in its centre a more or less considerable depression, as in the lily, the viola rothomagensis, &c.

Semilunar or crescentic (stigma semilunatum,) as in the yellow fumitory (corydalis lutea.)

Like the style, the stigma may be simple and undivided, as in borage (borago officinalis,) the cowslip, &c.

Bifid (stigma bifidum,) divided into two narrow divisions, as in the sage, the greater number of labiate plants, of the syngenesious plants, &c.

Trifid (stigma trifidum,) as in widow wail, (cneorum tricoccum,) the narcissus, &c.

Quadrifid (stigma quadrifidum,) as in lead wort (plumbago europæa,) &c.

Multifid, when the number of its divisions is greater than four.

Bilamellated (stigma bilamellatum,) formed of

two laminæ which are moveable on each other; in mimulus. (See Pl. 6. fig. 3.)

According to its direction, the stigma is said to be:

Erect, when it is long and in the direction of the axis of the flower.

Oblique (stigma obliquum,) when its direction is oblique in regard to the axis of the flower.

Spiral, twisted like a cork-screw, as in the nigella hispanica, &c.

The surface of the stigma is sometimes glabrous, sometimes resembles velvet, as in the chelidonium glaucum, the mimulus aurantiacus, &c. It is pubescent in the plane tree.

The stigma is feathery (stigma plumosum,) when it is filiform, and has on either side a row of hairs disposed like the barb of a feather, as in many of the gramineæ.

Pencil shaped (stigma penicelliforme,) when the hairs are collected in small tufts or clusters, so as to form pencils, as in the triglochin maritimum, &c.

We have now examined and described the floral organs, namely, the pistil, the stamina, and the floral integuments. We have remarked, that the essence of the flower resides exclusively in the sexual organs, and that the calyx and corolla are to be considered as only accessory, that is to say,

as only favouring the performance of the functions, which nature has intrusted to the flower, to which, however, they contribute only indirectly. Accordingly they are very often observed to be wanting, without their absence appearing to have any influence on the phenomena and mutual action of the sexual organs.

The principal use of the floral integuments seems, therefore, to be the protection of the organs of reproduction until they are full grown, that is to say, until they are fit for fecundation.

Before we explain the phenomena of this important function, let us return once more to some general considerations respecting the flower.

The term anthesis has been applied to the whole of the phenomena which are exhibited at the period when all the parts of a flower, being fully developed, open, separate, and are expanded.

All plants do not flower at the same time of the year. In this respect there are very remarkable differences, depending as well on the nature of the plant, as on the greater or less influence of light and caloric; and lastly, on the geographical situation of the vegetable.

Flowers are one of the most beautiful ornaments of nature. If they all appeared at the same season, and at the same period, they would have vanished too soon, and vegetables would thus

continue too long destitute of their greatest ornament. Even winter, in spite of the severity of the weather, gives birth to several flowers. The snow drops, the snow flakes, the Christmas rose, the daphne, produce flowers while the earth is still covered with snow. But these examples are, as it were, only exceptions. Cold in fact appears to be unfriendly to the expansion of flowers, while on the contrary, a gentle and moderate heat favours and supports them. Accordingly, there appears to be a perpetual spring in those parts of the world, where the temperature continues moderate from one end of the year to the other. In our temperate climates, it is in spring, when a gentle and vivifying heat has succeeded to the rigours of winter, that their integuments become gradually separated, and the flowers begin to display their beauties to the world. In our climates, the months of May and June are those which give birth to the greatest number of flowers.

According to the seasons in which their flowers expand, plants have been divided into four classes, namely, into:

Vernal (plantæ vernales, vernæ,) those which flower during the months of March, April, and May; such are the violets, the primrose, &c.

Estival (plantæ æstivales,) those which flower from the month of June to the end of August: most plants belong to this class.

Autumnal (plantæ autumnales,) those which expand their flowers from September to December. Such are many species of aster, the meadow saffron (colchicum autumnale,) the chrysanthemum indicum, &c.

Hibernal (pl. hibernales, hibernæ,) all those that flower from nearly the middle of December to the end of February. Such are a great many of the mosses, of the jungermanni, the galanthus nivalis, the helleborus niger, &c.

From a consideration of the period at which different plants produce their flowers, Linnæus has established his Calendar of Flora. In fact there is a great number of vegetables whose flowers always appear regularly at the same time of the year. Thus, in the climate of Paris, the black helebore flowers in January; the hazel, the daphne mezereon, in February; the almond, peach, apricot, in March; the pear, tulips, hyacinths, in April; the lilachs and apples in May, &c.

Not only do the flowers of different vegetables blow at different periods of the year, but a great many of them open and close at certain hours of the day; some of them even never open except by night. Hence flowers are distinguished into the diurnal and nocturnal. The latter are less numerous than the former. Thus, the marvel of Peru (nyctago hortensis,) never expands its

flowers, until the sun has sunk below the horizon. Some flowers are so much in the habit of opening and closing at particular hours, that they may serve to shew the time of day. Linnæus, who was so ingenious in discovering the most interesting points of view for the consideration of flowers, made use of the well known periods of the expansion of some species to form a table, which he called Flora's time-piece. In this table the plants are arranged according to the hours of the day at which their flowers are known to expand.

The different states of the atmosphere appear to have a marked influence on the flowers of certain vegetables. Thus the calendula pluvialis closes its flowers when the sky is covered with clouds, or when there is a storm impending. On the contrary, the sonchus sibiricus never opens its flowers but when the weather is misty, and the atmosphere is loaded with clouds.

The more or less vivid light of the sun appears to be one of the causes that acts with greatest efficacy on the expansion of flowers. In fact, its absence produces in the flowers, as well as in the leaves of the leguminous plants, a species of sleep. By very ingenious experiments, my friend, M. Bory de Saint Vincent, succeeded in making certain species of oxalis to flower, which had never done so naturally, by having them

strongly illuminated by night, in the focus of a lens.

The duration of flowers exhibits very considerable differences. Some open in the morning, and wither before the end of the day. These have received the name of ephemeral; such are most species of cistus, the tradescantia virginica, some species of cactus, &c. Others, on the contrary, retain their brilliancy for several days, and sometimes even for many weeks.

Lastly, there are some flowers whose colours differ at different periods of their expansion. Thus the hortensia begins with green flowers; by degrees they change to a beautiful rose colour, which, before they entirely wither, turns to a deep blue.

CHAPTER X.

OF NECTARIES.

Under the general denomination of nectaries (nectaria,) Linnæus has designated not only the glandular bodies observed in some flowers, where they secrete a sweet nectarious fluid, but also all those parts of the flower which, on account of their irregular and unusual forms, appeared to him not

to belong to the floral organs, properly so called, that is to say, neither to the pistil nor to the stamina, nor to the floral integuments.

It is easy to see that the very great extension given to this term, must have produced great uncertainty as to its true signification ; so much so, that it is perfectly impossible to give an exact definition of the word nectary, as used by Linnæus. A few examples will shew the justness of this observation.

Whenever any of the constituent organs of a flower exhibited any irregularity of form or of developement, or any alteration of its usual appearance, Linnæus gave it the name of nectary. It will be readily admitted, therefore, that he gave this name to a number of organs which are very distinct from each other.

Thus, in the columbine, Linnæus describes five nectaries, resembling five crooked spurs, pendant between the sepals ; in the delphinium there are two, which are prolonged into a sharp point behind, and are contained in the spur which is observed at the base of the upper sepal ; in the hellebore there are many of them, which are tubular, and seem to be two-lipped. Now these pretended nectaries of the hellebores, of the columbines, and, in general, of all the other genera of the family of the ranunculaceæ are nothing but petals.

In the nasturtium, the nectary is a spur which springs from the base of the calyx; in the toad flax it is a spur or prolongation from the base of the corolla. It is the same in the violet, the balsam, &c.

Linnæus has also given the name of nectary to collections of glands situated in different parts of the flower. Accordingly, it has been applied to the discs of the cruciferæ, umbelliferæ, and rosaceæ. In the lily, the nectary has the form of a glandular groove placed at the inner base of the divisions of the calyx; in the iris, it is a tuft of glandular hairs running along the middle of the outer divisions of the calyx.

In the gramineæ, the nectary is composed of two small scales of very various forms, placed at one side of the base of the ovary. These two scales form the glumella, an organ which never secretes. In the orchideæ, the name of nectary is given to the lower and inner divisions of the calyx, which other botanists, and Linnæus himself, distinguish by the name labellum. We might still farther multiply instances of genera which are said to have nectaries; but those which we have already enumerated are sufficient to shew how vague and indefinite is the meaning of this term in botanical language, seeing that it has been applied indiscriminately to petals, calyces,

stamina, abortive and deformed pistils, hypogynous, perigynous and epigynous discs.

If the term nectary is, after all, to be retained, we think it ought to be applied exclusively to masses of glands situated on different parts of the plants, and destined to secrete a sweet and nectareous juice, without, however, confounding it with the different species of discs, which are never known to secrete. In this manner might be removed the uncertainty and confusion produced by this term, and it might be restored to its true signication.

In commencing the study of the floral organs, we mentioned that the most complete flower was only the union of four verticils of leaves variously modified. It is a real bud, which, however, instead of giving birth to a shoot, has its merithalli so close to each other, that the different parts which compose the bud seem to grow from one and the same point, which is called the receptacle. Let us try to unfold this idea. And in the first place it is necessary to remark, that the number of verticils varies accordingly as the flower is more or less complete. Thus, in a female flower without floral integuments, there is but one verticil; there are two in an hermaphrodite flower without any perianth; three in that with a simple perianth, and four in the complete flower, that is

to say, in the flower which, within a double perianth, contains both stamina and pistils. Each of these verticils, as we have already observed, is composed of a variable number of leaves differently modified. This foliaceous nature of the constituent parts of the flower is very easily proved in regard to the calyx. In fact the sepals have generally the aspect and structure of true leaves; they are generally green, and traversed by projecting nerves containing spiral vessels. When all the leaves of the verticil are distinct from each other, the calyx is said to be polysepalous; but these leaflets may be united more or less intimately, in which case the calyx is said to be monosepalous or gamosepalous. The corolla is also formed of a verticil of leaves placed within the calyx, and on that account more altered in its nature; yet it is still easy to recognise in the petals of a great many flowers the same structure as in the calyx, with, however, some important modifications. Thus, for instance, the spirals and the stomata, which exist in the calyx as well as in the other leaves properly so called, are wholly wanting in the corolla. The leaflets which form the corolla may remain distinct or they may cohere. Hence the terms polypetalous, and monopetalous or gamopetalous corolla.

The stamina form the third verticil of the flower. Their analogy to the petals is very ob-

vious, inasmuch as the filaments of the stamina are frequently seen to expand into petals, as may be seen in all the double flowers. Thus, the filament of a stamen may be considered as a petal reduced to its midrib. With respect to the anther, it is a leaf whose edges are curved and rolled towards the midrib, so as to form two small bags, which are filled with cellular tissue, whose vesicles become ultimately separated from each other, and form the pollen. The pistil too may be regarded as resulting from a verticil of one or more leaves. When it is one celled, and its ovules are attached only to one point of its interior, it is composed of a single leaf, whose edges meet and unite so as to form the ovarian cavity. When, on the contrary, the ovary is many celled, or even when it is one celled, with the ovules attached to several parietal placentas, in such a case it is composed of as many leaves as there are cells or valves. In the case of the many celled ovary, the edges of the leaves converge towards the axis of the flower, and uniting with each other laterally by a part of their outer surfaces, they form the partitions; in the case of a one celled ovary, the ovarian leaves are united by their whole circumference. Lastly, the ovules themselves may be considered as a species of small buds, consisting of several leaves, which are variously modified.

Let it not be supposed that the theory which we have here very briefly propounded, respecting the nature of the flower and of the parts that compose it, is one of those speculative notions which too often embarrass the study of the sciences. It is founded on an accurate observation of nature, and it is no uncommon event to see certain flowers, which are designated by the name of monstrosities, exhibit more or less completely the different parts in their regular and original state, that is to say, having the aspect and the structure of true leaves. There is no botanist who has not had frequent opportunities of observing such a phenomenon. To cite but one very striking example of it we shall just mention, that we are now in possession of a flower of the nasturtium (tropæolum majus,) which M. Du Petit Thouars was good enough to supply us with, and in which the calyx, corolla, stamina, pistils and ovules had the form of leaves, together with the natural and relative positions of the different constituent parts of the flower. A similar phenomenon may also be observed in many of the cruciferæ, and among others in the turritis glabra.

Thus then, it may be said that the flower is a true terminal bud, composed of a variable number of verticils of leaves which are differently modified.

CHAPTER XI.

OF FECUNDATION.

The discovery of the male and female organs in vegetables has opened a new field for observation, by directing attention to the phenomena of their mutual action upon each other. It is only since that discovery that the mechanism of fecundation has been thoroughly understood. But here we may take occasion to remark, that the great truths which are useful to mankind have been at all times perceived, as if by a peculiar instinct, even by those who could not give any explanation of them. Thus, although the discovery of the sexes in vegetables does not ascend higher than two centuries, yet, from time immemorial, the inhabitants of Arabia had remarked, that to enable the date palm and the pistachia to bear fruit, it was necessary they should be close to others of the same species, which were observed never to produce any. Accordingly they often went to great distances in search of male branches, for the purpose of shaking them over the female flowers, which by that means were converted into perfect fruits: but they were wholly ignorant of

the cause of these phenomena, having no idea of the existence of the two sexes in vegetables.

Until lately we were as much in the dark respecting the mechanism of fecundation in plants as in animals. However, it was known that the female organ was fecundated; that the ovules or rudiments of seeds contained within the ovary become fit for developement, and for producing, in due time, individuals which are perfectly similar to the parent, whenever the pollen contained within the cells of the anther has made a due impression on the stigma; but the nature of the influence exercised by the pollen on the stigma was wholly unknown to us. The recent inquiries of several observers, and particularly those of Amici and Brongniart, have thrown great light upon this important question, and shews that fecundation in plants seems to have the same mechanism and the same cause as in animals.

Here, as well as in her other works, we have reason to admire the wisdom of nature, and the perfection of the instruments she employs for her purposes. Animals endowed with voluntary motion, and capable of moving at pleasure from one place to another, have, in general, the organs of reproduction separated on two individuals. The male at certain periods seeks the female and approaches her.

Vegetables, on the contrary, being destitute

of the power of locomotion, and irrevocably fixed to the place which has given them birth, being obliged to live and die there, have usually both the sexual organs united, not only on the same individuals, but generally even in the same flower. Accordingly, vegetables are most usually hermaphrodite.

Yet there are many of them which, at first view, might appear not to be placed in such favourable circumstances, and in which fecundation might seem abandoned by nature and left to mere accident. It is obvious that I speak of monœcious and diœcious vegetables. Here, in fact, the two sexual organs are often at very considerable distances from each other. But here again we have reason to admire the wisdom of nature, instead of accusing her; for in vegetables the pollen exists in the form of a light dust, whose particles are capable of being transported through the air, to distances which are often inconceivable. We may also remark, that very frequently, in monœcious plants, the male flowers are situated towards the upper part of the vegetable, so that when the pollen escapes from the cells of the anther, it falls naturally, by its own weight, on the female flowers which are placed below the former. Hermaphrodite flowers are unquestionably those in which all the accessory circumstances are most favourable to fecundation. The two sexual organs are, in fact,

united in the same flower. This function begins at the moment that the cells of the anther open to set the pollen free. There are plants in which the dehiscence of the anthers, and therefore fecundation, is effected before the complete expansion of the flower; but in the greatest number of vegetables, it never happens before the floral integuments become expanded. In certain hermaphrodite flowers, the length or shortness of the stamina in regard to the pistil, might at first appear to be an obstacle to fecundation. But, as Linnæus has ingeniously remarked, when the stamina are longer than the pistils, the flowers are in general erect; on the contrary, they are reversed in those whose stamina are shorter than the pistil. It is unnecessary to remark how favourable such a disposition is to fecundation. When the stamina are of the same length with the pistil, the flowers are indifferently erect or pendulous.

In order to favour the escape of the pollen, and its coming in contact with the stigma, the sexual organs of a great many vegetables execute very sensible motions.

At the period of fecundation, the eight or ten stamina that compose the flowers of the rue (ruta graveolens) become alternately erect towards the stigma, deposit on it a part of their pollen, and afterwards return to their former position.

The stamina of the sparmannia Africana, and of the barberry, when irritated with the point of a needle, contract and approach one another.

In several genera of the family of the urticeæ, such as the pellitory of the wall, the paper mulberry, &c. the stamina are inflexed towards the centre of the flower, below the stigma. At a certain time they become erect elastically, like so many springs, and scatter their pollen on the female organ.

In the genus kalmia, the ten stamina are situated horizontally in the bottom of the flower, and their anthers are enclosed in an equal number of small grooves which are seen in the base of the corolla. For the purpose of fecundation, each of the stamina forms a slight curve in order to disengage its anther from the little depression that contains it. It then rises above the pistil, on which it sheds its pollen.

The female organs of certain plants appear also endued with motions, which depend on a greater degree of irritability at the time of fecundation.

Thus the stigma of the tulip, and of several other liliaceæ, swells, and appears more humid at the above period.

The two laminæ which compose the stigma of the mimulus approach, and are pressed against one another whenever a grain of pollen or any foreign body happens to touch them.

It even appears, from the observations of M. M. Lamarck and Bory Saint Vincent, that several plants disengage, at this period, a very sensible heat. Thus in the arum Italicum, and several other plants of the same family, the spadix which supports the flowers disengages such a quantity of caloric as to be perceptible by the hand that touches it.

A great many aquatic plants, such as the nymphæa, villarsia, menyanthes, &c. have their flower buds at first concealed under water; by degrees they are seen to approach the surface, to rise above it, and to expand; and when fecundation is effected, to sink again below the surface, in order to ripen their fruit.

But yet, fecundation can be effected in plants which are wholly submersed in water. Thus M. Ramond has found at the bottom of one of the lakes of the Pyrenees the ranunculus aquatilis, covered with several feet of water, and yet bearing flowers and fruits which were perfectly ripe. Fecundation must have therefore been effected in the midst of that fluid. My friend M. Batard, author of the Flora of the Maine et Loire, had an opportunity of seeing the same plant in a similar situation. He made the curious remark, that each flower which was thus submersed, contained, before expansion, a certain quantity of air between its membranes, by means of which fecun-

dation was performed. The air which he found thus enclosed in the floral integuments before expansion, evidently proceeded from vegetable expiration, whose phenomena we have already considered.

This observation, whose accuracy has been often verified since that period, explains perfectly the mode of fecundation in submersed plants, when possessed of floral integuments; but it is impossible to apply it to vegetables without either calyx or corolla. Such are ruppia, zostera, zanichellia, and some others, whose fecundation is effected, although their flowers are wholly immersed in water.

But how does the pollen act on the stigma? Heretofore, the opinion most generally received by botanists was, that each grain of pollen represents a species of small vesicle, full of a liquid, containing a great quantity of small grains, which were considered as the true fecundating substance. As soon as these grains of pollen escape from the anther, they adhere to the stigma, whose surface is in general unequal, viscid, or covered with hairs. There they expand and open, the liquor which they contain is poured out on the stigma, and fecundation is thus effected.

The curious observations of M. Adolphus Brongniart on the generation of vegetables, have thrown new light upon this interesting subject.

When the grains of pollen are placed in contact with the surface of the stigma, they throw out their tubular appendage, which, when the surface of the stigma is naked, insinuates itself more or less deeply between its vesicles. The granules of pollen are soon collected towards the free extremity of the appendage, which swells and becomes slightly opaque, after which the grain of pollen shrinks and withers. Shortly after, the extremity of the appendage opens, and the granules of pollen are laid bare, and brought in contact with the mucilaginous matter of which we have already spoken, as uniting together the vesicles of the stigma. There they are seen under the appearance of small masses, which are observed successively to penetrate deeper in the direction of the style. When the vesicles of the stigma are covered with epidermis, the tubular appendage is applied to its surface, and adheres to it by its extremity. As they both open, the granules of pollen, in this case too, are brought in contact with the intercellular substance of the stigma.

The spermatic granules, observes Brongniart, pass, therefore, into the intercellular spaces of the stigma; but there they meet with no vessels for their conveyance, as was pretended by some authors. Link supposed them to be transmitted through the parietes of the cells; Brongniart, on the contrary, thinks it is by the intercellular

spaces. He says that in the potiron, the vesicular tissue uniting the stigma and the ovules, shews no globules in its intervals before fecundation; but when once it is effected, the brown streak produced by the spermatic granules is very easily traced in that yellow tissue as far as the ovules. The cells never contain any; the granules always, and in every instance, appear in their intervals. This transfer appears to be effected in virtue of the hygroscopicity of the granules. Having thus reached the ovule, the granules of pollen penetrate by the opening in both its membranes, as far as the kernel, either directly by the aperture, or, as Brongniart thinks, by a delicate membranous tube, which issuing from the kernel, applies itself to the placenta, where it takes up the fecundating granules to convey them into the interior of the ovule. This tube terminates within at the point where the embryo is to be formed, that is to say, at the small vesicle, which Malpighi has called the *sac of the amnios*. This vesicle is in some respect the mould in which the embryo is formed. After impregnation, opaque granules are seen to be produced in it, which are often green, and which ultimately form the embryo. The neck connecting the little vesicle with the sac of the kernel, contracts, bursts, and forms the radicle of the embryo.

Such is the theory of the generation of vege-

tables, as resulting from the observations of Needham, Smith, Amici, and particularly of M. A. Brongniart. We may observe that it has a very striking analogy to the same process in animals; particularly if we admit the theory of spermatic animalcules.

This explanation appears to be conformable to nature in most cases; but there are others in which the phenomena of fecundation do not proceed in the same manner. In plants which live always under water, it is clear that the grains of pollen do not adhere to and burst upon the stigma, and yet fecundation is effected. The surface of the stigma in a great many plants is extremely smooth, and not at all viscid; that of the chesnut is hard and coriaceous; the pollen cannot therefore adhere to it. In several of the apocyneæ and orchideæ, the pollen, instead of exhibiting a powdery substance, composed of an immense number of fine light molecules, forms a perfectly solid mass. The anther opens, the mass of pollen never changes its situation, remains quite entire, and yet fecundation is performed. Now in this case, the pollen has not left the interior of the anther for the purpose of pouring its fecundating fluid on the stigma. By the opening of the anther it is simply brought in contact with the atmospheric air, and yet the plant has been fecundated.

It is in order to furnish an explanation of these facts, that many authors have supposed that fecundation in vegetables might be sometimes effected without the immediate contact of the pollen with the stigma, and only through the influence of a kind of emanation or *aura pollinaris.* But this question remains yet to be decided.

In monœcious and diœcious vegetables, notwithstanding the separation, and often the distance of the two sexes, fecundation is still accomplished.

With respect to diœcious vegetables, atmospheric air is the vehicle whereby the pollen or aura pollinaris, by which they are fecundated, is often transported to immense distances. Butterflies and other insects by flying from flower to flower, also serve for the transmission of pollen.

In diœcious plants, in the palms, for instance, fecundation may be artificially performed. There had been long in the botanic garden of Berlin a female plant of the chamærops humilis, which flowered annually, but never produced fruit. Gleditsch procured from Carlrushe panicles of the male flowers, and shook them over the female flowers, which had the effect of producing perfect fruit. This experiment was often repeated afterwards.

This artificial mode of fecundation has been practised from time immemorial in Egypt, and in

the other parts of Africa, where the date palm is abundantly cultivated. At the time of flowering, it is the practice to mount to the top of the female plants, and to shake over them panicles of the male flowers, in order to cover them with pollen. M. Delile tells us, that during the campaigns of Egypt, from the constant hostilities of both parties, this practice could not be resorted to, and that, therefore, the date harvest completely failed. Linnæus held, not only that a single flower of a plant could be fecundated artificially by this process, but that it was possible to fecundate only a single cell of a many celled ovary, by bringing the pollen in contact with only one division of the stigma. It has been proved however, that although the pollen touched but one of the lobes of the stigma, all the other cells of the ovary were equally fecundated. It has been also proved by experience, that fecundation in diœcious plants takes place at very considerable distances. We have several well authenticated instances of this fact. In the garden of plants at Paris, two trees of the female pistacia had been many years cultivated, and were every year loaded with flowers, but never produced fruit. How great was the astonishment of the celebrated Bernard de Jussieu, when one year he observed the fruit setting in both, and come to perfect maturity! He immediately conjectured, that there must be in

Paris or near it, a male plant of the same species, bearing flowers. On inquiry, he found that at the same period, a male pistacia had flowered in the nursery of Chartreux near Luxembourg. In this case, as well as in the former, the pollen, conveyed by the wind, passed over the houses of a part of Paris to fecundate the female flowers.

The valisneria spiralis, a diœcious plant which I have had frequent opportunities of observing in the canal of Languedoc, and in the rivulets about Beaucaire, presents an interesting phenomenon at the period of fecundation. The plant is attached at the bottom of the water, and is wholly submersed. The male and female plants grow together. The female flowers borne upon peduncles of about two to three feet long, which are twisted spirally, so as to resemble a cork-screw, appear at the surface of the water for the purpose of expanding. The male flowers, on the contrary, are enclosed many together in a membranous spathe, which is borne upon a very short peduncle. When the period of fecundation arrives, they burst the spathe, are detached from their support and from the plant they belong to, and come to the surface of the water in order to expand and to fecundate the female flowers. Soon after the latter, by the retraction of their spiral peduncles, sink again below the water's surface, where they arrive at perfect maturity.

But in whatever manner fecundation may be effected, it always shews its influence by the effects produced by it. The flower which was before fresh, and embellished with the most beautiful colours, soon lays aside its transient splendour. The corolla withers ; the petals decay and fall off. The stamina having performed the office for which nature has created them, participate in the same changes. In a short time the pistil stands alone in the centre of the flower. The stigma and the style being now useless to the vegetable, decay and fall off with the other parts. The ovary alone is persistent ; for within it nature has deposited, for their growth and expansion, the rudiments of future generations.

The ovary, by its developement, is destined to become the fruit. It is nothing uncommon to see the calyx persistent upon this organ, and accompany it until it is perfectly ripe. Now it is worthy of remark, that this circumstance chiefly happens when the calyx is monosepalous : if the ovary is inferior or parietal, the calyx is then necessarily persistent, because it intimately adheres to it.

In the winter cherry (physalis alkakengi) the calyx survives fecundation, acquires a red colour, and forms a vesicular shell which contains the fruit. In the narcissus, the apple, the pear, and in short, in all plants with an inferior or parietal

ovary, the persistent calyx forms the outer wall of the fruit. Soon after fecundation the ovary begins to grow. The ovules which it contains, being at first of a watery substance, and scarcely organised, by degrees acquire a greater consistence; the part which is to form the perfect seed, that is to say, the embryo, is successively developed; all its organs are distinctly formed, and the ovary soon acquires the characters fit to constitute it a fruit.

We here conclude what relates to the flower, properly so called, considered in its whole and in the different parts that compose it. Before we pass to the fruit, we must describe an accessory organ of the flower, which is sometimes wanting, but which, when it does exist, is of great importance for the arrangement of plants in natural families. This organ is the disc. We shall afterwards consider the insertion, that is to say, the relative position of the different parts of the flower, and chiefly of the sexual organs.

Of the Disc.

The disc is a fleshy body of a glandular nature, usually yellow, more rarely green, situated either under the ovary, or on its summit, or on the inside of the calyx.

The disc is distinguished into the hypogynous, perigynous, and epigynous.

The hypogynous disc bears the name of podogynum, when it forms a fleshy body distinct from the receptacle, and raising the ovary above the bottom of the flower, as in the rue, and the other plants of the same family; that of pleurogynum, when it grows under the ovary, and ascends on one of its lateral surfaces, as in the periwinkle. It is called epipodium, when it is formed of several tubercles which grow on the support of the ovary. This variety of disc is particularly remarked in the family of the cruciferæ.

The perigynous disc is formed of a fleshy substance of greater or less thickness, spread over the inside of the calyx, as in the cherry, the almond, and in certain species of diosma, which, in that respect, differ from the other species of the same genus.

The epigynous disc is that which is observed on the top of the ovary when inferior, that is to say, when it is united at all points of its outer surface with the tube of the calyx, as in the umbelliferæ, the rubiaceæ, &c.

Of the Insertion.

The insertion of the stamina is distinguished into the absolute and relative. The former de-

notes the position of the stamina without any reference to the pistil; thus are the stamina inserted into the corolla, calyx, &c. The other denotes the position of the stamina or of the monopetalous staminiferous corolla with respect to the pistil. In this sense we say that the stamina are inserted under the ovary, around the ovary, or on the ovary.

Thus there are three kinds of insertion which bear the name of hypogynous, perigynous, and epigynous.

The hypogynous insertion, is that in which the stamina, or the monopetalous corolla bearing the stamina, are inserted under the ovary. For example in the cruciferæ, the labiatæ, &c.

The perigynous insertion is that which is made into the calyx, as in the rosaceæ. Lastly, in the epigynous insertion which occurs whenever the ovary is inferior, the stamina or monopetalous staminiferous corolla are inserted on the top of the ovary. The umbelliferæ, rubiaceæ, &c. afford examples of it.

The position of the disc usually determines the insertion. Thus whenever there is an hypogynous disc, the insertion is hypogynous; it is perigynous when the disc is perigynous. Lastly, it is epigynous when there is an epigynous disc on the top of the ovary.

SECTION II.

OF THE FRUIT, OR OF THE ORGANS OF FRUCTIFICATION PROPERLY SO CALLED.

When fecundation is performed, the floral integuments decay and perish, the stamina fall off, the stigma and style abandon the ovary, which alone has received new life from the influence of the pollen. This new period of vegetable existence commences from the moment when the ovary is fecundated, and ends at the dispersion of the seeds. It has received the name of fructification.

The fruit is, therefore, nothing more than the ovary fecundated and increased. It is essentially composed of two parts, the pericarp and the seed.

CHAPTER I.

OF THE PERICARP.

The pericarp is that part of the ripe and perfect fruit which is formed of the parietes of the fecundated ovary, and contains within it one or

more seeds. It is that which determines the form of the fruit.

The pericarp is always present; but it is sometimes so thin, and adheres so closely to the seed, that it is difficult to distinguish it in the ripe fruit. In this case several authors have supposed it not to exist, and that the seed is naked, as in the umbelliferæ, the labiatæ, the synanthereæ, &c.; but it is now proved that there are no naked seeds, and that the pericarp is never wanting.

The pericarp usually exhibits on some point of its outer surface, in general towards its upper part, the remains of the style or of the stigma, which indicates the organic summit of the pericarp, and, therefore, of the fruit.

The pericarp is always composed of three parts; namely, of a thin external membrane, a species of epidermis, which determines its form and covers it on the outside. This is called epicarp. Of another internal membrane, which lines the seminiferous cavity, and has received the name of endocarp. Between these two membranes there is a fleshy, parenchymatous part, which is called sarcocarp or mesocarp. These three parts, intimately united, constitute the pericarp.

When the ovary is inferior, that is to say, whenever it is united with the tube of the calyx,

the epicarp is composed of the tube of the calyx, whose parenchyma is confounded with the sarcocarp. In this case it is always easy to distinguish the origin of the epicarp; for at its upper part it ought to exhibit, at a variable distance from the origin of the style and of the stigma, a more or less projecting border, composed of the remains of the calycine limb, which has been destroyed by fecundation.

The sarcocarp or the mesocarp, is the parenchymatous part in which all the vessels of the fruit are united. It is very much developed in fleshy fruits, such as peaches, apples, melons, pumpkins, &c. In fact, all the flesh of these fruits is composed of the sarcocarp.

The endocarp, or inner parietal membrane of the fruit, is that which lines the seminiferous cavity. It is almost always thin and membranous; but it sometimes happens to be thickened externally by some portion of the sarcocarp. When this part of the sarcocarp becomes hard and osseous it covers the seed, and forms what is called a stone or nut when there is but one seed in the fruit, and nuculæ, when there are many.

When the pericarp is thin and dry, it may appear at first that there is no sarcocarp. No doubt, that if by this term we are always to understand a thick, fleshy, and succulent part, it is very often wanting. But the true distinctive character of the

sarcocarp is to be the vascular portion of the pericarp, that is to say, to contain the vessels which convey nutriment to the entire fruit. Now, as the pericarp always contains such vessels, there must be always a sarcocarp. Sometimes, however, in fruits which are perfectly ripe and dry, it is exceedingly thin ; yet if the pericarp be carefully examined, there will be observed between the epicarp and endocarp broken vessels, by which they were united, and which are the remains of the sarcocarp. As this part is full of aqueous juices before the fruit is ripe, after the evaporation of those juices, it seems to have disappeared, and not to exist.

The inner cavity of the pericarp, or that which contains the seeds, may be simple. In this case the pericarp is said to be one-celled (pericarpium uniloculare,) as in the poppy (papaver somniferum.) At other times, there is a more or less considerable number of cells or partial cavities. Hence the terms bilocular, trilocular, quinquelocular, multilocular, given to the pericarp accordingly as it has two, three, five, or a greater number of distinct cells. The cells of a pericarp are separated by an equal number of vertical plates, which take the name of partitions (dissepimenta.) All true partitions are formed after the same manner ; namely, by the reflection inwards of the endocarp in the form of two thin

plates, which are placed back to back, and cemented together by a very thin layer of sarcocarp. Such is the mode of formation of all true dissepiments. Those which are not thus formed must be considered as false dissepiments. It happens in some dissepiments, that the cellular part of the sarcocarp, which unites the two layers of endocarp, dries, in which case the layers are disunited and sensibly removed from each other. This, at first view, may appear to increase the number of cells of the pericarp. But the cavities arising from this cause may be easily distinguished, by observing that the plates of the endocarp have one of their surfaces covered with broken vessels.

Besides their mode of origin and formation, another distinctive character of true dissepiments is, to be always alternate with the stigmas or their divisions.

Certain fruits, on the contrary, have false dissepiments; such are those of the cruciferæ, of many of the cucurbitaceæ, of the poppy, &c. False dissepiments are distinguished from the true; 1°. by not being formed of a duplicature of the endocarp, properly so called; 2°. because, in general, they correspond to each of the stigmas or of their divisions, instead of being alternate with them, like the true dissepiments.

Dissepiments are distinguished into the complete and the incomplete. The former are those,

which are reflected inwards from the top of the pericarpal cavity to its bottom without any interruption. The latter, on the contrary, are not continued from the base to the summit; so that the adjoining cells communicate with each other. The datura stamonium affords an example of these two kinds of dissepiments, united in the same fruit. If we make a transverse section of it, it will exhibit four cells, and therefore four partitions. But of these partitions only two are complete; the other two do not reach the top of the cavity of the pericarp. They ascend to two-thirds of its height, and at their upper part they leave a free communication between the two cells, which they separate below.

In order to recognise easily, and to name correctly the different parts which compose the pericarp, and to distinguish them from those which belong to the seed, it will be necessary to establish the exact limit between these two organs. As every seed derives nourishment from the pericarp, it follows necessarily that it must communicate with it at some point of its surface. This point has received from botanists the name of hilum, or umbilicus. The hilum must be considered as the precise limit between the pericarp and the seed; that is to say, that all the parts without the hilum, or above it, belong to the pericarp; and, on the contrary, that all those below the hilum must be

looked upon as forming a part of the seed. The seeds are attached in the pericarp to a peculiar fleshy body, of variable forms and magnitudes, which is called trophosperm.* At the inner point of the pericarp where the trophosperm is attached, the endocarp is always perforated ; for, as the sarcocarp is the only vascular part of the pericarp, and supplies exclusively the materials necessary for the nutrition of the seed, the endocarp must have an opening to admit the vessels to that organ.

The trophosperm has sometimes but a single seed ; at other times it has a great many. When its surface has manifest prolongations, each of them bearing a seed, they are called podosperms ; as for example, in the leguminous plants, the caryophylleæ, the portulaceæ, &c.

The trophosperm, or the podosperm, usually terminates at the hilum. When it is prolonged beyond that point, so as to cover the seed in the whole or a considerable part of its surface, that prolongation is called arillus. The arillus being only an expansion of the trophosperm, belongs not to the seed, as is usually supposed, but to the pericarp.

Let us now examine, in succession, the diffe-

* The Placenta of most authors.

rent internal parts of the pericarp ; namely, the dissepiments, the trophosperm, and the arillus.

§ 1. *Of the Dissepiments.*

We have already said that the name of dissepiments is given to parts which differ widely from each other ; but, at the same time, we explained the mode of formation of true dissepiments. All those, therefore, which do not possess such an organization, that is, which are not constituted by two plates of endocarp, bent inwards and cemented together by a continuation of the sarcocarp, must be considered as false dissepiments.

The partitions are in general longitudinal, so as to reach from the base to the summit of the pericarpal cavity.

In some very rare cases, as in the cassia (cassia fistula,) and some other leguminous plants, they are transverse.

Dissepiments, as has been already observed, are also divided into the complete and the incomplete. We shall not now return to this distinction, which has been already sufficiently explained.

The origin of false partitions is extremely variable. Sometimes they are formed by a more or less considerable projection of the placenta, as in the poppy ; at other times, on the contrary,

they are produced by the bending inwards of the valves of the pericarp, &c.

§ 2. *Of the Trophosperm, or Placenta.*

The placenta is that part of the pericarp to which the seeds are attached. Sometimes it has on its surface a greater or less number of small projecting nipples, each bearing a single seed, which have received the name of podosperms, or umbilical cords.

When a pericarp is many-celled, the placenta usually occupies its centre, and in that case it is called central. It is then formed by the union and cohesion of the partitions, and has, in the re-entrant angle of each cell, a more or less considerable projection.

The form of the placenta is very variable. It is spherical, and almost globular in many of the primulaceæ, in the anagallis arvensis for instance.

Cylindrical, in several caryophylleæ, such as the silene armeria, the cerastium arvense, &c.

Trigonal in the polemonium cæruleum.

Radiating (radiatum,) in the cucurbitaceæ, &c.

According to its consistence, the placenta may be :

Fleshy, like that of the rue (ruta graveolens,) of the saxifraga granulata.

Corky, or having the consistence of cork, as in the thorn apple (datura stramonium,) the tobacco (nicotiana tabacum,) &c.

According to its position, it is said to be central or axile, when it occupies the centre or axis of the pericarp. For example, in the campanula, the digitalis, &c.

Parietal, attached to the walls of the cells of the pericarp. In this case it is called unilateral, when it is attached at one side only of the pericarp, as in most of the leguminous plants and of the apocyneæ.

Bilateral, attached to two sides of the inner cavity of the pericarp, as in the gooseberry, &c.

The umbilical cord or podosperm also presents very various forms. Sometimes it is slender and filiform, as in the gilliflower, the gooseberry, the ash, &c.

Unciform or hooked, in the acanthus mollis, &c.

At other times, on the contrary, it is thicker and larger than the seed.

§ 3. *Of the Arillus.*

The arillus, as we have already observed, belongs essentially to the pericarp, inasmuch as it is but a prolongation of the placenta. It is an error, therefore, to consider it with some bota-

nists, as a part of the seed, to which it is merely applied without adhering to it, except at the circumference of the hilum.

Few parts of the vegetable exhibit so many varieties of form and of nature as the arillus. Accordingly, it is very difficult to give such an exact definition of it as shall be applicable to all cases.

In the nutmeg tree (myristica officinalis,) the arillus forms a fleshy integument of a clear red colour, divided into narrow unequal segments. This is the part used in pharmacy under the name of mace. The polygala vulgaris has a three-lobed arillus, which is but slightly developed, and forms a crown at the base of the seed.

In the spindle tree (euonymus europæus,) and in the broad leaved species (euonymus latifolius,) the orange coloured arillus covers and conceals the seed on all sides. In the euonymus verrucosus it forms an irregular cup, which is open at the top.

From the small number of examples which we have quoted, we may see that this organ is extremely variable, as well in its colour as in its form and consistence. But its origin being the same in all cases, it will be always easy to distinguish it, notwithstanding the numerous forms under which it may present itself.

Several parts have been often taken for the

arillus ; for instance, the outer fleshy part of the proper integument of the seed, in the jasmin, the tabernæmontana, &c. ; the endocarp, as in the coffee (coffæa arabica,) the rutaceæ, &c.

It is a general law, to which as yet there has appeared no exception, that the arillus never occurs in plants whose corolla is monopetalous. The tabernæmontana might seem to be an exception to this law ; but when better examined, its pretended arillus is only the outer part of the proper integument of the seed, which is soft and fleshy.

We have now studied the constituent parts of the pericarp ; namely, the dissepiments, the cells, the placenta, and the arillus. We shall therefore return to some considerations respecting the pericarp in general.

In the pericarp, as well as in the ovary, are distinguished its base, or the point by which it is connected with the receptacle or the peduncle ; its summit, which is indicated by the situation of the style, or of the sessile stigma ; and lastly its axis. Sometimes the axis is material, and has a real existence : it is then called columella. At other times, on the contrary, it is fictitious or rational, that is to say, represented by an imaginary line passing from the base to the summit of the pericarp, and running through its centre.

The columella forms a kind of small column, which supports the different parts of the fruit, and which continues in the centre of the pericarp, when they have fallen: for example, in the euphorbiaceæ, the umbelliferæ, &c.

As the seeds are contained in the pericarp, it is necessary, in order to allow them to escape from it when ripe, that it should have some particular mode of opening. The name of dehiscence is given to the act whereby the pericarp opens naturally. Yet there are pericarps which never open. These have received the name of indehiscent; such are those of the synanthereæ, of the labiatæ, of the gramineæ, &c.

Among the pericarps which open naturally when ripe, we may distinguish those which burst into irregular pieces, whose number and form are exceedingly variable, and which are called ruptile pericarps; those that open at the top by teeth which are at first very close to each other, such as many of the caryophylleæ; those which open only by holes made at their upper part, as in the antirrhinum; and lastly, such as divide into a determinate number of distinct pieces, which are called valves. The latter are the true dehiscent pericarps.

The number of the valves of a pericarp is always known by the number of longitudinal sutures visible on its outer surface. The true valves are

always equal in number to the cells of the pericarp. Thus a dehiscent fruit, which is four-celled, shall have also four valves. However, there are some exceptions. The capsule of the violet has but a single cell, and it opens by three valves.

In some fruits, each of the valves divides into two pieces, so that their number appears the double of that which ought naturally to exist.

A pericarp is said to be two valved (pericarpium bivalve,) when it divides spontaneously into two equal and regular valves, as in the lilach, the veronica, &c.

Trivalved (pericarpium trivalve,) that which opens into three valves ; such are those of the tulip, of the lily, of the violets, &c.

Quadrivalved (pericarpium quadrivalve,) as in the epilobium, the thorn apple.

Quinquevalved (pericarpium quinque valve,) that which opens by five valves.

Multivalved (pericarpium multivalve,) when it divides into a greater number of distinct valves or segments.

The valvar dehiscence may take place in different ways, in regard to the relative position of the valves and dissepiments. Hence there are three species of valvar dehiscence.

Either the dehiscence takes place in the middle of the cells, that is to say, between the parti-

tions, which in that case correspond with the middle part of the valves, (valvis medio septiferis.) This is called loculicidal, as in most of the ericineæ. At other times the dehiscence occurs opposite to the partitions, which it often divides into two layers. It is then called septicidal, as in the scrophularineæ, the rhodoraceæ, &c.

Lastly, it has received the name of septifragal dehiscence, when it bursts near the dissepiments which remain free and entire on the separation of the valves, as in the bignonia, the calluna (erica vulgaris.)

In general the dehiscence takes place by longitudinal sutures. In some cases, however, the sutures are transverse, and the valves are the one above the other. This species of fruit has received the name of pyxidium; the henbane, the pimpernel, and the plantain, are examples of it.

The pericarp, or the fruit considered as a whole, is one of the organs whose forms are most numerous and most varied. Thus it is sometimes spheroidal and rounded, as in the peach, the apricot, the orange, &c.

Ovate, like that of a great many oaks, &c.

Lenticular, that is, approaching the form of a lens, as in many of the umbelliferæ.

Prismatic, that is to say, having the form of a many-sided prism, as in the oxalis.

Its summit may be acute or obtuse; some-

times the style is persistent, and forms a more or less remarkable point on the fruit. At other times it is the stigma that acquires a greater developement, as in most species of clematis and in many anemones, in which it forms a kind of feathery appendage at the top of the fruit.

The fruit may be crowned by the teeth of the calyx, when the ovary is inferior or parietal, as in the pomgranate (punica granatum,) the apple, the pear, &c.

At other times it is surmounted by a down (pappus,) a small tuft of silky hairs, which must be regarded as a true calyx. This is what may be observed in almost all the species of the numerous tribe of the synanthereæ.

Excellent generic characters are taken from the form and structure of the pappus.

Thus the down may be sessile (pappus sessilis,) that is to say, immediately applied to the top of the ovary without the intervention of any other body, as in the genera hieracium, sonchus, prenanthes, &c. (See Pl. 8. fig. 12.)

In other genera, on the contrary, it is borne on a species of little pivot, which is called stipes, and the pappus is said to be stipitate (pappus stipitatus,) as in the genera lactuca, tragopogon, &c. (See Pl. 8. fig. 13.)

The hairs which compose the down may be simple and undivided; in this case the pappus is

said to be hairy (pappus pilosus,) as in the lactuca, prenanthes. (See Pl. 8. fig. 13.)

At other times they are feathery, that is to say, giving rise laterally to other smaller and finer hairs, which are also shorter, so as to resemble the barb of a feather. The pappus is then called feathery (pappus plumosus,) as in the genera leontodon, tragopogon, picris, cynara, &c. (See Pl. 8. fig. 12. a.)

In the valerians, the pappus, which is manifestly nothing more than the limb of the calyx, is at first rolled inwards, and appears under the form of a small circular protuberance at the top of the ovary; but sometime after fecundation the calyx is seen to unrol itself, to be drawn out, and to form a true feathery pappus.

The pericarp also frequently presents a species of membranous appendages in the form of wings, as the elm, the maples, (see Pl. 8. fig. 6.) According to the number of these appendages it is said to be dipterous, tripterous, tetrapterous, &c. Many genera of the family of the sapindaceæ and of the acerineæ, afford examples of these different species of fruits. At other times it is covered with long coarse hairs resembling flax, as in the lontarus, or even it is covered with spines, as the horse chesnut, the thorn apple (datura stramonium, &c.)

The organization of the pericarp and of the

seed being one of the most difficult parts of botany, in order to give a clear idea of the different organs which we have described in this chapter, we shall give the analysis of some well known fruits, and name the different parts that compose them; after which we shall briefly review the different objects that we shall have successively examined.

Let us take the fruit of the peach tree (amygdalus persica) as an example. (See Pl. 8. fig. 8.)

The fruit being composed essentially of two parts, namely, of the pericarp and of the seed, it will be first necessary to distinguish them from each other. We have seen that the seed is always contained within the pericarp; let us, therefore, try to find it in the centre of that organ. If we cut a peach in two, we shall find its centre occupied by a cell or cavity, containing a single seed, and rarely two. The seed being once distinguished, all without it belongs to the pericarp. Let us now give a name to these different parts. And first, we find on the outside a thin coloured pellicle, covered with a very short down, which is easily removed; this is the pericarp. The internal cavity of the pericarp is lined with another smooth membrane, adhering intimately and confounded with the hard part that forms the nut; this is the endocarp. The whole of the thick,

fleshy, parenchymatous substance, contained between the latter membrane and the epicarp forms the sarcocarp. But to which of the three parts does the bony nut belong which is formed within? Is it, as was long supposed, a proper covering of the seed, a thick and woody endocarp, or does it form a part of the sarcocarp? It will be very easy to resolve these questions. For let us examine in what manner the osseous part is formed. If we take a young peach long before it is ripe, and cut it across, we shall meet with no resistance; as yet there will be no solid nut. Now at this period the three parts of the pericarp are extremely distinct from each other, and the endocarp clearly exists under the form of a simple membrane applied to the inner surface of the sarcocarp. But soon after, the part of the sarcocarp which is next to the inner membrane, is observed to become gradually whiter, closer, and to pass in succession through all the intermediate degrees before it acquires the osseous solidity which it possesses when ripe. Now in this case, although this portion of the sarcocarp is intimately united and confounded with the endocarp, it ought not, in any manner, to be referred to it, but more properly to the sarcocarp, because it is really composed of that part. The nut or bony part in the centre of the peach is, therefore, formed of the endocarp, to which is added an

ossified portion of the sarcocarp. What we have said of the peach is equally true of the apricot, the plum, the cherry, the almond, &c.

If we take the fruit of the common pea (pisum sativum.) (See Pl. 8. fig. 3.) known by the name of pod, and analyse it, we shall find first:

That the fruit is oblong and compressed, so as to have two sharp edges, on which are two longitudinal sutures, which indicates that, when ripe, it opens by two segments or valves. It is, therefore, a two valved pericarp. If cut longitudinally, it is found to have but a single cavity, containing eight or ten seeds, that is to say, that it is one celled and many seeded. The seeds are all attached at the upper suture to a kind of small projecting border, which runs along the suture, and has a distinct prolongation for each seed. Every thing without the seed is a part of the pericarp. Let us name the parts. On the outer surface is a thin membrane closely adhering to the subjacent part; this is the epicarp. The inner cavity is lined with another membrane, which adheres less intimately; this is the endocarp. The fleshy, green, vascular part, which lies between the two membranes, although not very thick, constitutes the sarcocarp. The small longitudinal prominence which runs along the sutures, and to which the seeds are attached, is the trophosperm, or placenta. Each of its prolongations be-

longing to a particular seed, is a podosperm or umbilical cord.

To recapitulate, we see that the pericarp is that part of the fruit which forms the walls of the simple or multiple cavity which contains the seeds; that it is always composed of three parts, namely, of the epicarp, or membrane that covers it externally; of the endocarp, or membrane lining its inner cavity; of a more or less thick and fleshy part, sometimes, however, thin, and difficult to distinguish, but always vascular, which is called sarcocarp or mesocarp: that frequently the pericarp is divided within by dissepiments into a more or less considerable number of cells, whence it is called bilocular, quadrilocular, multilocular, &c. The part of the pericarpal cavity to which the seeds are attached, has a fleshy swelling, which is more or less developed, proceeding from the sarcocarp, which has received the name of trophosperm. When the trophosperm or podosperm cover the seed so as to embrace it to a greater or less extent, this peculiar prolongation takes the name of arillus. Such are the parts that enter into the composition of the pericarp. Let us now examine the seed.

CHAPTER II.

OF THE SEED.

We have seen that the fruit is essentially composed of two parts, the pericarp and the seed.

The seed is that part of a perfect fruit which is contained in the inner cavity of the pericarp, and which encloses the body that is destined to reproduce a new vegetable. There are no naked seeds, properly so called, that is to say, destitute of a pericarp. But the latter is sometimes so thin, and adheres so closely to the seed, that it is difficult to distinguish it in the ripe fruit, as the two are intimately united and confounded with each other. Yet the two parts were quite distinct in the ovary after fecundation. Hence the great necessity of carefully studying the structure of the ovary, in order to learn that which should belong to the fruit.

Thus in the grasses and the synanthereæ, the pericarp is thin, and adheres very intimately to to the seed, from which it is difficult to distinguish it. It is the same in many of the umbelliferæ, &c.; whereas, if the ovary be examined,

these two parts are found to be very distinct from each other.

Every seed proceeds from a fecundated ovule. Its essential character is to contain an organized body, which, under favourable circumstances, becomes developed, and produces a being perfectly similar to that which gave it birth. This body is the embryo. The essence of the seed consists, therefore, in the embryo.

It is wrong, in our opinion, to give the name of seeds to the reproductive bodies of the ferns, of of the mosses, of the fungi, and of all the other agamic plants. In fact they contain nothing which resembles an embryo. It is true, however, that by their developement they form a vegetable, which is similar in all respects to that from which they have sprung. But it is not the embryo alone that is susceptible of such developement. The buds of perennial plants, and particularly the bulbils that grow on different parts of vegetables, often even within the pericarps instead of seeds, can equally produce a complete vegetable. Now, notwithstanding this great analogy of functions, no one was ever induced to consider bulbils and buds as true seeds. As the reproductive corpuscles of organic plants are perfectly analogous to them, they as little deserve the name of seeds.

The seed is composed of two parts: of the

episperm or proper integument; of the kernel, contained within the episperm.*

We shall consider these two parts separately, when we shall have examined in a general way the direction and position of the side with respect to the pericarp.

The point of the seed by which it is connected with the pericarp, is called umbilicus or hilum. The hilum is always marked on the proper integument with a kind of scar of greater or less extent, which never occupies but a part of the surface, and by means of which the vessels of the

* Such is in fact the most usual structure of the fecundated seed, when it comes to maturity; but this structure differs widely from that of the ovule before impregnation, which we shall now explain according to the curious observations which have been lately published by the celebrated Mr. R. Brown. Before fecundation the ovule is composed of two membranes and of a nucleus. The outer membrane, or the testa, has, sometimes near the hilum, at other times at a point which is more or less distant from it, a very small aperture, already observed by some of the old botanists, and to which Turpin has given the name of micropyle. This opening has no direct communication with the parietes of the ovary. According to Brown, it indicates the true basis of the ovule, and the point opposite to it is the summit. The nutritious vessels of the pericarp, which reach the ovule by the hilum, creep in the thickness of the testa towards its summit, where they form a kind of expansion, communicating with the inner membrane, and called chalaza. This inner membrane has a direction

placenta communicate with those of the proper integument of the seed.

The centre of the hilum always represents the base of the seed. Its summit is indicated by the point diametrically opposite to the hilum.

When a seed is compressed, the side that looks to the axis of the pericarp bears the name of face, properly so called; the other, which is turned towards the walls of the pericarp, is called the back (dorsum.) The edge of the seed is the line of union of the face and back.

When the hilum is situated on the edge of the

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opposite to that of the testa, that is to say, it is inserted by a pretty broad basis into the summit of the latter, the only point at which these two membranes have any communication. The summit of the inner membrane is also perforated with a small opening, which corresponds exactly with that of the base of the testa. The nucleus contained within both the integuments of the ovule is a cellular body, having always the same direction with the inner membrane, that is to say, being inserted into its base, or the point opposite to its perforated summit. It is composed of two parts, the one thick and cellular, which is the chorion of Malpighi, the other internal, forming a kind of cellular bag, which is at first often full of a mucilaginous fluid; this is the amnios with its liquor. It is in this inner bag that the embryo first begins to shew itself. Its radicle always corresponds with the summit of the nucleus, that is to say, with the aperture or base of the outer integument of the ovule. The albumen which often accompanies the embryo, may be formed either by the amniotic sac, or by the chorion, or by both these organs together.

seed it is said to be compressed (semen compressum.) On the contrary, it is said to be depressed when the hilum is on its face or back. It is very important to make this distinction.

It is important to consider the position of the seeds, and particularly their direction with respect to the axis of the pericarp, when they are of a determinate number. They then furnish excellent characters for the natural classification of plants,

Thus, every seed connected by its extremity with the bottom of the pericarp, or of one of its cells, when it is many-celled; whose direction it more or less pursues, is said to be erect (semen erectum,) as in all the synanthereæ.

On the contrary, it is said to be reversed (semen inversum,) when it is attached in like manner to the top of the cell of the pericarp; for example, in the dipsaceæ. In these two cases the placenta occupies the base or summit of the cell.

If, on the contrary, the placenta being axile, or parietal, the seed directs its summit (or the part diametrically opposite to its point of attachment) towards the upper part of the cell, it is called ascending (semen ascendens,) as in the apple, the pear, &c. (See Pl. 8. fig. 9.)

It is said, on the other hand, to be suspended (semen appensum,) when its summit looks to the

base of the cells, as in the jasmineæ and many of apocyneæ, &c.

The seed takes the name of peritropal (semen peritropum) when its rational axis, or the line which is considered to pass from its base to its summit, is transverse with respect to the walls of the pericarp.

§ 1. *Of the Episperm.*

The episperm, or proper integument of the seed, is nearly always simple and single around the kernel. Sometimes, however, as it has a considerable thickness, and is fleshy on its inside, its inner wall is detached and separated, so as to appear composed of two tunics; the one external thicker, sometimes hard and solid, to which Gærtner has given the name of testa; the other internal thinner, which is called tegmen. This disposition is very evident in the seed of the ricinus communis; but these two membranes are not more distinct from each other than the three parts that compose the pericarp.

The hilum is always situated on the episperm. In appearance and extent it is very variable. Sometimes it has the form of a simple point, which is scarcely visible. At other times, on the contrary, it is very large, as in the horse chesnut, for example, in which it is easily distinguished

by its whitish colour from the rest of the episperm, which is of a deep brown. Towards the central part of the hilum, sometimes near its margin, there is seen a very small opening, to which Turpin has given the name of omphaladium, and which affords a passage to the nutritious vessels, which proceed from the placenta to be distributed to the episperm. When this bundle of vessels is continued some way before it divides into branches, it forms a projecting line which has received the name of vasiduct or raphe. The inner point, where the vasiduct terminates, bears the name of chalaza or inner umbilicus. The vasiduct is often indistinct on the outside: it is then discovered only by the aid of dissection, as in many of the euphorbiaceæ. At other times it is very prominent and visible, as in the orange tree, where it is continued from one end to the other of the episperm.

In many seeds there is found a perforated organ near the hilum, usually at the side next to the stigma, which botanists designate, with Turpin, by the name of micropyle. Several authors think that it is by this aperture the fecundating fluid is conveyed to the young embryo.

Mr. Brown* considers this opening as the

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* See note to page 382.

base of the seed. The radicle of the embryo always exactly corresponds with it.

We sometimes observe at a greater or less distance from the hilum of some seeds, a body swelled into the form of a skull-cap, to which Gærtner has given the name of embryotegium, as in the date palm, the asparagus, the commelina, &c. During germination this body is detached, and affords a passage to the embryo.

The episperm is in general simply applied to the kernel, from which it is easily separated ; but it sometimes so closely adheres to it, that it cannot be removed without scraping it.

The episperm has neither cells nor partitions within it. Its cavity is always simple. Yet it may, in some rare cases, contain several embryos at once. But this superfætation is an anomaly, a kind of lusus naturæ, in which there is nothing fixed or constant.

§ 2. *Of the Kernel.*

The kernel or nucleus is the whole of the ripe and perfect seed contained in the cavity of the episperm. It has no kind of vascular communication with it, unless the two organs be united and confounded ; for in this case it is difficult to determine that no such communication exists.

The nucleus may be composed exclusively of

the embryo, as in the kidney bean, the lentil, the bean, &c.; that is to say, that alone it fills the entire cavity of the episperm. (See Pl. 7. fig. 3, 7.)

At other times, besides the embryo, the nucleus contains an accessory body, which is called endósperm,* as in the ricinus, the wheat, &c. (See Pl. 7. fig. 3. c.)

The structure of these organs is so different, that it will be easy at first view to distinguish them. The embryo, in fact, is a being essentially organized, which, by germination, is destined to grow and to be developed. The endosperm, on the contrary, is a mass of cellular tissue, sometimes hard and as it were horny, at other times fleshy and soft, which, by germination, decays and diminishes instead of increasing in size. Thus then, germination will remove all doubts respecting the nature of the two bodies contained in the episperm, when it cannot be done by analysis and dissection.

Of the Endosperm.

The endosperm is that part of the nucleus which forms round the embryo, or at the side of it, an accessory body which has no vascular commu-

* The perisperm of Jussieu; the albumen of Gærtner.

nication, or continuity of substance with it. In general it is composed of cellular tissue, in whose meshes is contained amylaceous fecula, or a thick mucilage.

This substance serves as nutriment to the young embryo. Before germination it is quite insoluble in water; but at that first period of vegetable life, it changes its nature, becomes soluble, and partly serves for the nourishment and growth of the embryo. It is always easy to separate the albumen from the embryo, because it is not in any way connected with it.

Its colour is usually white or whitish; it is green in the misseltoe (viscum album.)

The substance which forms it is in general very variable; thus it is:

Dry and farinaceous in a great number of the gramineæ, the wheat, the oat, the barley, &c.

Coriaceous, and as if cartilaginous, in a great number of the umbelliferæ.

Oleaginous and fleshy, that is to say, thick and unctuous to the touch, as in the ricinus and many other of the euphorbiaceæ.

Horny, tenacious, hard, elastic like horn, in the coffee and many other rubiaceæ, in most of the palms, &c.

Thin and membranous, like that of a great many labiatæ, &c.

The presence or absence of the albumen is a

very good generic character, particularly in the monocotyledons. This organ must, therefore, perform an important part in the natural classification of vegetables.

The albumen may exist in a seed, although its embryo should prove abortive, or be wholly wanting.

It is always single, even in cases where there are several embryos united in the same seed.

§ 4. *Of the Embryo.*

The embryo is that organized body contained in the perfect seed after fecundation, which constitutes the compound rudiment of a new plant. It is it, in fact, that when placed in a proper situation will, by the act of germination, become a vegetable perfectly similar in all respects to that from which it has taken its origin.

When the embryo exists alone in the seed, that is to say, when it is immediately covered by the episperm or proper integument, it is called epispermic (embryo epispermicus,) as in the kidney bean. (See Pl. 7. fig. 3, 4, 5, 6.)

If, on the contrary, it is accompanied with an endosperm, it takes the name of endospermic (embryo endospermicus,) as in the grasses, the ricinus, &c. (See Pl. 6. fig. 3, 4.)

The endospermic embryo may have different

positions with respect to the endosperm. Thus, sometimes it is simply applied to a point of its surface, where it is lodged in a small superficial depression, as in the grasses; or else it is rolled round the endosperm, which it more or less completely covers, as in the marvel of Peru. It has, in this case, received the name of embryo extrarius. (See Pl. 7. fig. 8.)

At other times it is wholly contained within the endosperm, which covers it on all sides; it then takes the name of embryo intrarius, as in the ricinus, &c. (See Pl. 7. fig. 3, 4.)

The embryo being a vegetable already formed, all the parts which are hereafter to be developed are already contained in it, but only in the rudimental state. As we have already remarked, this is the only difference between the embryo and the reproductive corpuscles of agamic plants.

The embryo is composed essentially of four parts; namely, of the radicular body, of the cotyledonary body, of the gemmule, of the caulicle.

The radicular body or the radicle, forms one extremity of the embryo. It is that which by germination is to produce the root, or to form it by its developement. (See Pl. 4. fig. 4. a. 8. a.)

In the embryo, before germination, the radicular extremity is always simple and undivided. When developed it often shoots out several small

fibres, which form so many radicular filaments, as in the grasses.

If in some cases it is difficult, before germination, to recognise and to distinguish the radicle, this distinction becomes very easy when the embryo begins to grow. In fact, the radicular body tends always towards the centre of the earth, whatever may be the obstacles which are opposed to it, and is changed into a root, while the other parts of the embryo take the opposite direction.

In a certain number of vegetables the radicular body itself is elongated and changed into a root, as an effect of its increase of size produced by germination. This is what may be observed in a great many dicotyledons. When the radicle is external and naked, the vegetables take the name of exorhizæ. Such are the labiatæ, the cruciferæ, the boragineæ, the synanthereæ, &c. and most of the dicotyledons. (See Pl. 7. fig. 5, 6, 7. a.)

In other vegetables, on the contrary, the radicle is wholly covered or concealed by a particular sheath, which bursts at germination to give it a passage outwards. This body has received the name of coleorhizon. In this case the radicle is enclosed, and the plants which have this character have received the name of endorhizæ. To this division is referred the greater part of the true

monocotyledons; such as the palms, the grasses, the lilies, &c. (See Pl. 7. fig. 10.)

Lastly, in some rarer cases, the radicle is united and incorporated with the albumen. The plants which have this organization are called synorhizæ. Such are the pines, the firs, and all the other cruciferæ, the cycadeæ, &c.

All the known phanerogamic plants may be arranged in these three classes. Accordingly, they may be substituted with advantage for those of the monocotyledons and dicotyledons, which are subject to a great many exceptions, as we shall see immediately.

2°. The cotyledonary body may be simple and perfectly undivided. In this case it is formed of a single cotyledon, and the embryo is called monocotyledonous (embryo monocotyledonus,) as in the rice, the barley, the wheat, the lily, &c. (See Pl. 7. fig. 7, 8.) At other times it is formed of two bodies united base to base, which are called cotyledons, and the embryo is then said to be dicotyledonous (embryo dicotyledonus,) as in the ricinus, the bean, &c. (See Pl. 7. fig. 3, 5, 6.)

All plants whose embryo has but a single cotyledon, bear the name of monocotyledonous; all those which have two cotyledons are called dicotyledonous.

The number of cotyledons in the same embryo

sometimes exceeds two; thus, there are three in the cupressus pendula; four in the pinus inops and the ceratophyllum demersum; five in the pinus laricio; six in the deciduous cypress (taxodium distichum;) eight in the pinus strobus; lastly, there are sometimes ten and even twelve in the pinus pinea.

We may, therefore, see that the number of cotyledons is not the same in all vegetables, and that the divisions into monocotyledons and dicotyledons, strictly observed, does not include all the known phanerogamic vegetables. Besides it often happens that the cotyledons become so intimately united, that at first view it is difficult to decide if the embryo be monocotyledonous or dicotyledonous, as for example, in the horse chesnut.

These are the reasons that have induced my father to select an organ different from the cotyledons, as the basis of his primary divisions of the vegetable kingdom. The radicle either naked or contained in a sheath, or lastly united with the albumen, affording more fixed and invariable characters, has been employed by him to form three great classes in the embryonate or phanerogamic vegetables, which are:

1°. The endorhizæ, or those whose radicular extremity of the embryo has a sheath containing one or more radicular tubercles, which tear it at

germination, and are changed into roots. These are the true monocotyledons.

2°. The exorhizæ, or those whose radicular extremity of the embryo is naked and becomes itself the root of the young plant; such are most of the dicotyledons.

The synorhizæ, or plants in which the radicular extremity of the embryo is intimately united with the albumen. This class, which is less numerous than the two former, contains the coniferæ, and the cycadeæ, which differ from other vegetables by such remarkable characters, and which the number of their cotyledons equally excludes from the class of monocotyledons and of dicotyledons.

The cotyledons appear to be destined by nature to favour the developement of the young plant, by supplying it with the first materials of its nutrition. In fact the cotyledons are always very thick and fleshy in plants which have no albumen, while they are thin, and, as it were, leafy in those which are possessed of it.

This may be easily seen by comparing the thickness of the cotyledons of the kidney bean and castor oil seed.

At the period of germination, sometimes the cotyledons remain hidden under the earth, and do not appear above it; in this case they are called cotyledones hypogei, as in the horse chesnut.

At other times they appear above the earth by the elongation of the neck, which separates them from the radicle; they are then called cotyledones epigei, as in the kidney bean and most of the dicotyledonous plants. When the two cotyledons are epigean and appear above ground, they form the two seminal leaves (folia seminalia.) (See Pl. 7. fig. 3. b. b.)

3°. Of the gemmule. The name of gemmule (gemmula,) is given to the little body, either simple or compound, which grows between the cotyledons, or in the very cavity of the cotyledon, when the embryo has but one of them. It formerly had the name of plumule (plumula.) As this organ has, in general, no resemblance to the body with which it is compared, but as, on the contrary, it always forms the first bud (gemma,) of the plant which is about to be developed, the name of gemmule is far more suitable, and ought to be preferred.

The gemmule is the rudiment of all the parts which are to be developed in the open air. It is composed of several small leaves folded in various ways, which when expanded by germination, become the primordial leaves, (folia primordalia.) (See Pl. 7. fig. 13. d. d.)

Sometimes it is free and visible externally before germination; at other times, on the contrary, it is apparent only when the latter has com-

menced; lastly, in some rare cases, it is hidden under a kind of integument, in some respects similar to that which covers the radicle of the endorhizæ, which is called coleoptilon. This integument should in most cases be considered as only a thin cotyledon, covering the gemmule like a tube.

4°. Of the caulicle (cauliculus.) This organ does not always very manifestly exist. It is confounded on the one hand with the base of the cotyledonary body, and on the other with the radicle, of which it is a kind of prolongation. It is by the growth of the caulicle during germination, that the cotyledons of some plants are raised above ground and become epigean.

After having thus studied in succession the four parts that compose an embryo, namely, the radicular body, the cotyledonary body, the gemmule and the caulicle, let us see what are the different positions of the embryo, with respect to the seed which contains it, or to the pericarp itself.

We have already seen that the embryo might be endospermic or epispermic, accordingly as it was accompanied with an endosperm, or as it formed alone the mass of the nucleus; that in the case where it was endospermic, it might be within or without the albumen; that is either contained in that body, or simply applied to some point of its surface. It is by means of the two extremi-

ties of the embryo that we determine its absolute and relative directions. The radicular extremity always forms the base of the embryo. Hence the embryo is said to be homotropus, when it has the same direction with the seed, that is to say, when its radicle corresponds to the hilum, as may be seen in many of the leguminosæ, of the solaneæ and of a great number of the monocotyledons.

The homotropus embryo may be more or less curved. When rectilinear, it takes the name of orthotropus, as in the rubiaceæ, the synanthereæ, the umbelliferæ, &c.

The embryo is said to be antitropal (embryo antitropus,) whose direction is opposite to that of the seed, that is to say, when its cotyledonary extremity is turned towards the hilum. This is what may be observed in the thymeleæ, the fluviales, the melampyrum, &c.

The name of amphitropal embryo (embryo amphitropus,) is given to that which is so curved on itself, that its two extremities approach, and are directed to the hilum, as may be seen in the caryophylleæ, the cruciferæ, and in several atripliceæ, &c.

As the monocotyledonous and dicotyledonous embryos differ widely from each other, in the number, form, and arrangement of the parts that compose them, we shall briefly explain the characters peculiar to each of them.

§ 5. *The Dicotyledonous Embryo.*

The dicotyledonous embryo, or that whose cotyledonary body has two very distinct lobes, possesses the following characters: its radicle is cylindrical or conical, naked and projecting; it is elongated at germination, and becomes the true root of the plant. Its two cotyledons are attached at the same height on the caulicle; and in many cases, their thickness is great in proportion as the the albumen is thin or not present. The gemmule lies between the two cotyledons, which cover it, and in a great measure conceal it. The caulicle is more or less developed.

Such are the characters common to dicotyledonous embryos in general. Some of them, however, present anomalies which at first might seem to remove them from this class. Thus, sometimes the two cotyledons are so united as to appear to form but one, as in the horse chesnut, and usually in the chesnut. But it will be remarked that this union is only accidental, for it does not always take place. This is actually the case in regard to the horse chesnut, and it shews it to possess the general organization of dicotyledonous embryos. Besides, we must consider every embryo as truly dicotyledonous, in which the

base of the cotyledonary body is completely cleft or divided in two, although it may appear simple and undivided at the top.

§ 2. *Of the Monocotyledonous Embryo.*

The monocotyledonous embryo is that which before germination is perfectly undivided, and has neither cleft nor incision.

If in the dicotyledonous embryo, it is easy in most cases to distinguish the different parts that compose it, it is not always so in the monocotyledonous embryo, where frequently all the parts are so united and confounded together, that they appear to form but one mass, so that germination alone can enable us to distinguish them. Accordingly, the organization of monocotyledonous plants is not so perfectly understood as that of the vegetables which have two cotyledons.

In the monocotyledonous embryo the radicular body occupies one of the extremities; it is more or less rounded, often projecting very slightly, and forms a kind of nipple, which is not very prominent. At other times, on the contrary, it is very large and flat, and forms the body of the embryo, as in most of the grasses. The embryo is then said to be macropodus. (See Pl. 7. fig. 8- 9.)

The radicle is contained in a sheath which it

bursts at germination. This radicle is not always simple as in the dicotyledonous plants; it is very often formed of several radicular filaments, each of which passes separately through the sheath that contains them, as may be observed in the grasses.

The cotyledonary body is simple, having neither cleft nor incision. Its form is extremely variable. It is always lateral with respect to the entire mass of the embryo. In general, the gemmule is contained within the cotyledon, which covers it on all sides, and forms for it a kind of coleoptilon. (See Pl. 7. fig. 9. b. 10. b.) It is composed of small leaves enclosed within each other. The outermost usually forms a kind of tube, which is closed on all sides, embracing and covering the others. M. Mirbel has given it the name of pileolus.

The caulicle does not in general exist, or else it is confounded with the cotyledon or the radicle. Such is the most usual organization of the monocotyledonous embryos; but sometimes there are modifications peculiar to certain vegetables. It is thus for instance that the family of the grasses have some peculiarities in the structure of their embryo. In fact it is composed of a thick fleshy body, which is in general discoid and applied to the endosperm; this body has received the name

of hypoblast:* this part never grows during germination; it may be compared to the radicular body; 2°. of the blast, or the part of the embryo which is to be developed. It is applied to the hypoblast, and is composed of the caulicle and of the gemmule. It lies within the cotyledon, which forms a kind of sheath or tube that covers it on all sides. The lower extremity of the blast, by which one or more radicular tubercles are to pass outwards, bears the name of radiculodium.

Lastly, the term epiblast is applied to an anterior appendage of the blast, which sometimes covers it partially, and seems to be but a simple prolongation of it.

CHAPTER III.

OF GERMINATION.

The term germination is applied to the series of phenomena through which a seed passes, that, when arrived at maturity, and placed in favourable circumstances, swells, bursts its integuments,

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* It is that which Gærtner calls vitellus.

and tends to unfold the embryo which lies within it. The germination of a seed requires the concurrence of certain circumstances depending on the seed itself, and of others, which are accessory and foreign to it, but which exercise an unquestionable influence on the phenomena of its developement.

The seed ought to be perfectly ripe; it ought to have been fecundated, and to contain an embryo which is perfect in all its parts. It is necessary also, that the seed be not too old; for it will have lost through time its germinative power. Yet there are some seeds that retain it for a considerable number of years; they are chiefly those belonging to the family of the leguminosæ. Thus there are examples of the germination of kidney beans that had been kept for sixty years; and there are quoted instances of the seeds of the sensitive plant having been perfectly developed about one hundred years after they had been gathered. But they must have been excluded from the contact of air, of light, and of moisture.

The external agents indispensable for germination are water, heat, and air.

Water, as we have already observed, is indispensable for vegetation, and for the phenomena of nutrition in vegetables. In this case it serves not only as an alimentary substance, but also by its solvent power and its fluidity, it serves as a

menstruum and as a vehicle for the food of the vegetable.

In germination, its mode of acting is precisely the same as in vegetation. In fact, it enters the substance of the seed, softens its integuments, causes the embryo to swell, and produces changes in the nature of the albumen and cotyledons, which enable them to supply the young vegetable with the first materials of its nutrition. It is also impregnated with the gaseous and solid substances which are to serve as nutriment to the young plant when it begins to grow. It moreover favours its developement by the decomposition it undergoes; its disunited elements combine with the carbon, and produce the different proximate principles of vegetables.

However, the quantity of water should not be too great; for in that case the seeds would undergo a kind of maceration, which would destroy their germinative power, and be opposed to their developement. We here speak of seeds belonging to terrestrial plants; for those of aquatic vegetables germinate when wholly immersed in water. Some of them, however, although the number is very small, rise to its surface in order to germinate in the open air, and could not be developed if immersed in that fluid.

Water, therefore, acts in two ways during the the germination of seeds: it softens their integu-

ments, so as to make them burst easily; and it serves as a solvent and a vehicle for the aliment of the young vegetable.

2°. Heat is equally necessary for germination with water. In fact it has a very marked influence on all the phenomena of vegetation. A seed placed in a situation whose temperature is below Zero, makes no attempt at developement, but remains inactive, and as it were torpid, while a gentle, moderate heat, is highly favourable to its germination. The temperature, however, ought not to exceed a certain limit; for otherwise, so far from favouring the developement of the germs, it would dry them up and destroy their vital principle. Thus a temperature varying from 132 to 144° of Farhenheit, is unfavourable to germination, while that which does not exceed 88 or 99, particularly if there is a certain degree of moisture, accelerates the evolution of the different parts of the embryo.

Air is as necessary for the growth and germination of vegetables, as it is indispensable for the respiration of animals. A seed which is wholly deprived of atmospheric influence can never germinate. Yet Homberg says, that he succeeded in making some seeds to germinate in the vacuum of an air pump. But although the experiment has been often since repeated, the same results could not be procured from it. It may be, therefore, ad-

mitted as certain, that air is necessary for germination. M. Theodore de Saussure, whose testimony is of the greatest weight in the experimental part of vegetable physiology, thinks that the experiments of Homberg do not, by any means, invalidate this truth, and that the conclusions he has drawn from them must be considered as imperfect and inaccurate.

Seeds which are buried too deeply in the earth, and thus withdrawn from the influence of atmospheric air, have often remained for a long time without any sign of life. When, from any cause, they are placed nearer to the surface, so as to be exposed to the surrounding air, they soon begin to germinate.

As the air is not a simple body, but is, on the contrary, a compound of oxygen and hydrogen, does its influence depend on the mixture of these two gases? Or are we to ascribe its effects on the phenomena of germination to one of them only?

The action of air on vegetables, at this first period of their developement, is similar to that which takes place in the respiration of animals. In fact, during respiration, it is the oxygen of the air that chiefly acts, by communicating to the blood the qualities by which it is adapted for the developement of all the organs; it is oxygen also that favours the germination of vegetables. Seeds

placed in nitrogen or carbonic acid gases will not germinate, and will shortly perish. We know that they produce a similar effect on the animals which are exposed to them. But pure oxygen will not act so favourably on the evolution of germs; for it first accelerates, but soon destroys it, by the excessive activity which it communicates. Accordingly seeds, plants, and animals, can neither grow, respire, nor live in pure oxygen gas. It requires to be mixed with another substance, which shall moderate its activity in order to be fitted for vegetation and respiration. It has been remarked that its mixture with hydrogen or azote made it fitter for that purpose, and that the best proportions for the mixture were one part of oxygen, and three parts of azote or of hydrogen.

The oxygen absorbed in germination, combines with the carbon contained in the young vegetable, and forms carbonic acid, which escapes. By this new combination, the principles of the albumen are no longer the same; its fecula, which was before insoluble, becomes soluble, and is often partly absorbed to serve as the first nutriment of the young vegetable.

Certain substances appear to have a very manifest influence in accelerating the germination of seeds. For a knowledge of this fact we are indebted to the experiments of Humboldt. This illustrious naturalist, to whom nearly all branches

of human knowledge are indebted for some of their improvements, and often for the perfection at which they have now arrived, has demonstrated that the seeds of the lepidium sativum, placed in a solution of chlorine, germinated in five or six hours; whereas in pure water the same seeds required thirty-six hours to arrive at the same result. Certain exotic seeds, which had resisted all the means employed to make them germinate, became perfectly developed in a solution of the same gas. He has also remarked, that all the substances which are capable of readily yielding a portion of their oxygen to water, such as many of the metallic oxides, nitric and sulphuric acids sufficiently diluted, hastened the germination of the seeds, but at the same time produced the effect which we noticed in regard to oxygen, namely, that of exhausting the young embryo and causing it soon to perish.

The earth in which the seeds are placed in order to make them germinate, is not a condition absolutely necessary for their developement; for seeds are frequently seen to germinate very rapidly on fine humid sponges, or on other bodies which are kept moist with water. However, let it not be imagined that earth is not useful to vegetation; the plant draws from it, by its roots, substances which it is able to assimilate, after converting them into nutritive elements.

So far from hastening the developement of the embryo, light has manifestly the power of retarding it. In fact it is well ascertained, that seeds germinate much more rapidly in the dark than when exposed to the light of the sun.

All seeds do not require the same time to make them germinate. In this respect there are even very remarkable differences. Thus, some seeds germinate in a very short time; the garden cress in two days; spinage, turnip, and kidney beans in three days; lettuce in four days; melons and gourds in five days; most of the grasses in one week; hyssop after one month. Others take a very considerable time before they shew any signs of developement. These are chiefly such as have a very hard episperm, or such as are surrounded with a ligneous endocarp, like those of the peach and of the almond, which do not germinate before one year; the seeds of the hazel, of the rose, of the cornel, and of many others, which do not germinate until two years after they are planted.

Having taken a rapid review of the accessory circumstances favourable to germination, let us now consider the several phenomena of that function, after which we shall enter into some details respecting the peculiarities which it presents in the monocotyledonous and dicotyledonous vegetables.

The first visible effect of germination, is the swelling of the seed and the softening of the integuments that cover it. These integuments burst after the lapse of a certain time, which varies in the different vegetables. This bursting of the episperm takes place in a very irregular manner, as in the kidney bean, in the common bean; at other times, on the contrary, it presents an uniformity and regularity which are observed in every individual of the same species. This is chiefly visible in seeds provided with an embryotegium, a kind of lid which is detached from the episperm, in order to give exit to the embryo; as for instance, in the Virginian spiderwort (tradescantia Virginica,) in the commelina communis, in the date palm (phœnix dactylifera,) and in many other monocotyledonous plants.

From the moment the embryo begins to be developed, it takes the name of plantula. It is distinguished into two extremities, which always grow in opposite directions. The one is formed by the gemmule, and grows upwards into the air and light; this is called the caudex ascendens. The other, on the contrary, sinks into the earth, and pursuing, therefore, a direction opposite to the former, bears the name of caudex descendens: this is formed by the radicular body.

In the greatest number of cases, the caudex descendens, or the radicle, is the first to expe-

rience the effects of germination. In the exorhizæ, this extremity is observed to become more prominent, to lengthen, and to form the root. In the endorhizæ, on the contrary, the coleorhizon, stretched by the radicular tubercles which it contains, is sometimes elongated, and yields to a considerable distension before it breaks. At other times it yields immediately, and permits the radicular tubercles which it covered to escape.

During this time the gemmule does not remain inert and stationary. At first concealed between the cotyledons, it becomes erect, elongated, and seeks the surface of the earth, when it has been placed under it. If there be a coleoptilon, it is lengthened and expanded; but the gemmule, more rapid in its growth, presses on it, pierces it at its upper part or laterally, and appears in the open air.

When the caudex ascendens begins to grow below the insertion of the cotyledons, it raises them above the surface of the earth. These cotyledons are called epigean.* They become developed, and sometimes even they grow thinner, and, as it were, foliaceous, and bear the name of seminal leaves.

If, on the other hand, the caudex ascendens begin to grow only above the cotyledons, they

* From επι upon, and γη the earth.

remain concealed in the earth, and so far from gaining an increase of size, they diminish, decay, and at last they wholly disappear. They are then called hypogean cotyledons.*

When once the gemmule has reached the open air, the leaflets that compose it are unfolded, become expanded, and soon acquire all the characters of leaves, whose functions they begin to perform.

But what are the uses of the accessory parts of the seed, that is to say, of the episperm and of the albumen?

The use of the episperm, or proper integument of the seed, is to prevent the water or other substances in which seeds are placed for the purpose of germination, from acting in too direct a manner upon the embryo. It seems to perform the office of a sieve, through which the minutest earthy particles alone can find a passage. In fact, Duhamel has remarked, that the seeds which are stripped of their proper integument seldom germinate, or that they produce slender and deformed vegetables.

The albumen, which is not always present, is only the residue of the water contained in the cavity of the ovule in which the embryo was developed. This fluid, which Malpighi has com-

* From ὑπο under, and γη the earth.

pared to the aqua amnii, when it has not been wholly absorbed during the formation and growth of the embryo, gradually becomes thicker, and ultimately forms a solid mass, which either contains the embryo, or to whose surface it is simply applied. This mass is the albumen. This is the reason that the body in question has always an inorganic appearance. Sometimes the whole of the fluid contained within the ovule is not changed into a solid mass; but a portion of it retains the liquid form. This is what is very distinctly observed in the fruit of the cocoa tree, for instance, which contains in its nut a more or less considerable quantity of a whitish mild emulsion, which is known by the name of milk. The origin and first use of the albumen point out the office which it is destined to perform at the period of germination. In fact, it supplies the plant with its first nutriment. By the changes which it then undergoes in its chemical composition, and in the nature of its elements, it is well adapted for this use. Yet the albumen in some vegetables is so hard and compact, that it requires a long time to soften, and to resolve itself into a more or less fluid substance, which is capable of being absorbed by the embryo. But in all cases it must take place. If the embryo be separated from its albumen, it will never be developed. It is clear,

therefore, that this organ is intimately connected with its growth.

In many cases, the cotyledons appear to perform an office similar to that of the albumen. It was on this account that the celebrated naturalist, Charles Bonnet, called them the mammæ of vegetables. If we remove the two cotyledons of an embryo, it will decay and shew no signs of developement. If we remove but one, it may still vegetate, but in a very weak and languid manner, like a diseased and mutilated being. But it is a very remarkable fact, that we may, with perfect impunity, slit and divide into two lateral portions a dicotyledonous embryo, that of the kidney bean for instance. If each part contain an entire cotyledon, it will grow as well as a perfect embryo, and will produce a vegetable which shall be equally strong and vigorous.

Lastly, as is proved by the experiments of M. M. Desfontaines, Thouin, Labillardiere, and Vastel, it is sufficient to water the cotyledons in order to see the whole embryo grow, and its parts expanded.

The great difference of structure between the monocotyledonous embryos, and those which have two cotyledons, exerts a considerable influence on their modes of germination. We therefore think it necessary to examine separately the phenomena of each, in order to explain in the clearest man-

ner the mechanism of that function in those two great classes of vegetables. We shall begin with the dicotyledonous embryos, as it is in them that the developement of the different organs that compose them can be most easily observed.

§ 1. *The Germination of Dicotyledonous Embryos.*

In the dicotyledonous embryo, the radicle is generally conical, and projects externally. The caulicle is usually cylindrical; the gemmule is naked, and concealed between the bases of the two cotyledons, which are situated face to face, and immediately applied to each other.*

Such is the position of the different parts of the embryo before germination. Let us see what are the changes it undergoes at the commencement of that function. The better to understand what we are about to explain, let us take for an example the kidney bean, and pursue it through all the stages of its developement. (See Pl. 7. fig. 1, 2, 3, 4, &c.) We shall first see the entire mass of the seed to be impregnated with moisture, and to swell; and the episperm to burst irregularly. In a short time the radicle, which formed

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* In a few cases the cotyledons are distant, and more or less divergent, as in the monimia and ruizia of the family of the monimieæ.

a small conicle nipple, begins to lengthen; it sinks into the earth, and produces small lateral ramifications, which are extremely delicate. Soon after, the gemmule, which has been hitherto concealed between the two cotyledons, becomes erect, and appears externally. The caulicle is lengthened, and raises the cotyledons above ground in proportion as the radicle sinks into the earth and ramifies. The two cotyledons are then separated; the gemmule is perfectly free and naked; the small leaves that compose it expand, increase in size, become green, and already begin to draw from the atmosphere a part of the fluids that are employed in the growth of the young plant.

At this point germination is completed, and the second period of vegetable life begins.

When the embryo is endospermic, that is to say, when it is accompanied with an albumen, the phenomena proceed in the same order, but the albumen acquires no increase of size; on the contrary, it is seen to soften, and gradually to disappear.

Some dicotyledonous vegetables have a peculiar mode of germination. Thus, for example, some embryos are often found to have already germinated in the cavities of certain fruits, which are perfectly closed on all sides. This is frequently observed in the fruits of the orange tree,

where it is not uncommon to meet with several seeds already in a state of germination.

The mangrove tree (rhizophora mangle,) which inhabits the marshes and banks of the sea between the tropics, has a peculiar mode of germination, which is equally remarkable with the latter. Its embryo begins to be developed while the seed is still contained in the pericarp. The radicle presses against the pericarp, which it wears, and ultimately pierces. It is lengthened externally, sometimes more than a foot. The embryo is then detached, leaving the cotyledonary body in the seed. It falls, the radicle foremost, and sinks into the soil, where it continues to grow.

In the horse chesnut, in the chesnut, and in some other dicotyledonous vegetables, the two cotyledons, which are very large and thick, are, in general, immediately united with each other. Germination is then effected in the following manner. The radicle, in descending into the earth, lengthens the base of the two cotyledons, and thus disengages the gemmule, which soon appears above ground; but the two cotyledons are not carried up by the gemmule; they remain under ground.

§ 2. *The Germination of Monocotyledonous Embryos.*

On account of the uniformity of their internal structure, monocotyledonous embryos experience, in general, fewer changes during germination than those of dicotyledonous vegetables. In fact, they often appear like fleshy bodies, in which it is difficult to distinguish the parts that compose them. Accordingly, it is necessary to make these embryos germinate, in order to have a perfect knowledge of their structure. As in the dicotyledons, the radicular extremity is usually the first developed. It lengthens and its sheath bursts in order to give exit to the radicular tubercle, which expands and sinks into the earth. Several radicles usually grow from the lateral and lower parts of the caulicle. When they have acquired a certain developement, the principal radicle is destroyed and disappears. Accordingly, the monocotyledonous never have a vertical root like the dicotyledonous vegetables.

The cotyledon which contains the gemmule always grows more or less before it is perforated by the latter. In general, the gemmule escapes by the lateral part of the cotyledon and never by its summit. In fact, it is always nearer to one side of the cotyledon, and its summit is always oblique.

When the gemmule has perforated the cotyledon, the latter changes into a kind of sheath, which embraces the gemmule at its base. (See Pl. 7. fig. 14. b. c.) It is this sheath that has received the name of coleoptilon.

But it very often happens, that a part of the cotyledon is engaged either within the albumen, or in the episperm, so that the part which is next the radicle alone is drawn out by the developement of the latter. (See Pl. 7. fig. 10. c.)

CHAPTER IV.

CLASSIFICATION OF THE DIFFERENT SPECIES OF FRUITS.

In the two foregoing chapters we have carefully examined the organs that enter into the composition of a ripe and perfect fruit. We have seen that it is always composed of two parts, the pericarp and the seed.

We must now make known the different modifications of the fruit, considered as a whole, that is to say, as the union of the different parts that compose it.

It is obvious, that there must be a great many

species of fruits, which are all more or less distinct from each other, when we consider the varieties of form, of structure, and of consistence, and the variable numbers and relative positions of the seeds, &c., by which fruits are diversified. Accordingly, their classification has always been considered as one of the most difficult subjects of botany. Notwithstanding the labours of a great many distinguished botanists, who have made it their particular study, the classification of fruits has not yet arrived at the same degree of accuracy and precision with the other branches of the science. Some authors have proposed to unite, under one denomination, some species that are essentially distinct from each other in their form and structure; others, on the contrary, by multiplying without end the number of divisions, and establishing them on characters which are too minute or too variable, have equally injured the progress of this part of carpology. Accordingly, we shall in this work describe only such species of fruits as are very distinct and well characterised; in short, only those that have been consecrated by usage, or adopted by the greater part of botanists.

Fruits, considered in general, have been divided in various ways, and have received particular names. Thus, we call that a simple fruit, which proceeds from a single pistil, contained in one flower, such as that of the peach, of the cherry,

&c. On the contrary, a multiple fruit is that which arises from several pistils contained in one and the same flower; as the strawberry, the raspberry, that of the ranunculus, of the clematis, &c. Lastly, the name of compound fruit is given to that which results from a more or less considerable number of pistils united and often coherent, but all belonging to distinct flowers which are very close to each other, as that of the mulberry.

According to the nature of their pericarps, fruits are distinguished into the dry and the fleshy. The former are those whose pericarp is thin, or formed of a substance which is furnished with a very small quantity of juices; the latter, on the contrary, have a thick and succulent pericarp, and their sarcocarp in particular is very much developed; such are melons, peaches, apricots, &c.

Fruits may continue completely closed on all sides, or they may open in a greater or less number of pieces, called valves; hence, the distinction of fruits into the dehiscent and indehiscent. The former, when dry, have also the name of capsular fruits.

According to the number of seeds they contain, fruits are divided into the many-seeded and few-seeded. The few-seeded are those which contain but an inconsiderable number of seeds, a number which is in general accurately known.

Hence the epithets one-seeded, two-seeded, three seeded, four-seeded, five-seeded, given to the fruit, to express that the number of its seeds is one, two, three, four, five, &c.

The many-seeded fruits are all those that contain a considerable number of seeds, which it is not intended to determine.

There are fruits whose pericarps are so thin, and adhere so closely to the seed, as not to be distinguished from it. Linnæus regarded these fruits as naked seeds: they have received the name of pseudosperms. Such are those of the gramineæ, of the labiatæ, of the synanthereæ, &c.

It is very important to have an accurate knowledge of, and to be able to distinguish the different species of fruits. In fact this organ very often serves as a basis for the arrangement of plants in natural families; and the characters which are derived from a profound examination of it, lead in general to the most happy results in the methodical classification of vegetables.

In order to simplify the study of the nomenclature of fruits, we shall divide them into three classes. In the first we shall place the simple, that is to say, all those which proceed from a single pistil, contained in one flower. We shall subdivide this class into two sections, the one containing dry fruits, and the other fleshy fruits. The second class shall contain the fruits resulting

from the union of several pistils in the same flower, that is to say, multiple fruits. Lastly, in the third class we shall treat of compound fruits, or of those that are formed by several flowers at first distinct, but which become united, so as to constitute by their union but a single fruit.

FIRST CLASS.

OF SIMPLE FRUITS.

SECTION I.

DRY FRUITS.

§ 1. *Dry and Indehiscent Fruits.*

Dry and indehiscent fruits contain, in general, but a very small number of seeds. Their pericarp is generally very thin, or adheres to the proper integument of the seed. This induced the old botanists to consider them as naked seeds, or as destitute of pericarps. These are the true pseudosperms, and are distinguished into the following species:

1°. The caryopsis, a one-seeded indehiscent fruit, whose very thin pericarp adheres intimately to the seed, and cannot be distinguished from it. This species belongs nearly to the entire family of the grasses, such as wheat, barley, rice, &c.

Its form is variable. It is ovate in the wheat, long and narrow in the oat, irregularly spheroidal in the Turkey wheat.

2°. The achenium, a one-seeded indehiscent fruit, whose pericarp is distinct from the proper integument of the seed; as in the synanthereæ, the sun-flower, the thistle, &c. The achenium is very often crowned by bristles or scales, which constitute what we have designated by the name of down (pappus.) (See Pl. 8. fig. 12, 13.)

Sometimes the pappus forms a simple, small, membranous crown, which stands as a circular border on the upper part of the fruit (pappus marginalis.)

At other times it is feathery or silky, according to the nature of the hairs that compose it.

3°. The polakenium. This term is applied to a simple fruit, which separates, when perfectly ripe, into two or a greater number of cells, each of which may be considered as an achenium. Hence the names diakenium, triakenium, pentakenium, according to the number of these divisions. Example: the umbelliferæ, the parsley, the hemlock, the araliaceæ, &c.

In the umbelliferæ it is a diakenium; in the nasturtium a triakenium; and a pentakenium or polakenium, properly so called in the Araliaceæ.

4°. The samara. A fruit containing but few seeds, coriaceous, membranous, greatly compressed, having one or two indehiscent cells, and often extended laterally into wings or broad appendages. For example, the fruit of the elm

(ulmus campestris,) of the maple tree, &c. (See Pl. 8. fig. 6.)

5°. The gland (glans,) a one-celled indehiscent fruit, which is one-seeded from the constant abortion of several ovules, always proceeding from an inferior, many-celled, and many-seeded ovary, whose pericarp adhering intimately to the seed, has always at its summit the very small teeth of the calycine border. It is partially, seldom wholly, contained in a kind of scaly or foliaceous involucre, called cupula. For example, the fruit of the oaks, of the hazel, &c. (See Pl. 8. fig. 7.)

The form of glands is, in general, very variable. Some of them are long, others round, and as it were spherical. In some, the cupula is scaly and very short; in others, it is greatly developed, and covers nearly the whole fruit.

6°. The carcerulus. A dry, many-celled, many-seeded, indehiscent fruit; such is that of the lime tree.

7°. The fruits are called gynobasic, when the cells are so distant from each other as to appear to be so many distinct fruits, and when, in consequence of the great depression in the axis of the fruit, the style seems to grow immediately from the disc or gynobasis. Such is the fruit of the labiatæ, of the boragineæ, which is composed of four acheniums united at their base upon a common receptacle; that of the simaroubeæ, &c.

§ 2. *Dry Dehiscent Fruits.*

Dry dehiscent fruits are, in general, many-seeded; the number of valves and cells that compose them is very variable. In general, they are designated by the name of capsular fruits.

1°. The follicle (folliculus,) a fruit either twin, or solitary by abortion, usually membranous, one-celled, one-valved, opening by a longitudinal suture, to which is attached internally a sutural placenta, which becomes free by the dehiscence of the pericarp. Rarely, the seeds are attached to both the edges of the suture. This species of fruit belongs to the family of the apocyneæ, such are the rose bay (nerium oleander,) the asclepias syriaca, and vincetoxicum, &c. (See Pl. 8. fig. 11.)

2°. The siliqua, a dry, oblong, two-valved fruit, whose seeds are attached to two sutural placentas. It is usually divided into two cells, by a false dissepiment parallel to the valves. This fruit belongs to the cruciferæ; examples, the wall flower, the cabbage, &c. (See Pl. 8. fig. 1.)

The silicula scarcely differs from the former. This name is given to a siliqua, whose length does not exceed four times its breadth. The silicle contains but one or two seeds. Such are the

fruits of the thlaspi, of the lepidium, of the isatis, &c. (See Pl. 8. fig. 2.) This too belongs to the cruciferæ.

4°. The pod or legume (legumen,) is a dry two-valved fruit, whose seeds are attached to a single trophosperm, which runs along one of the sutures. This fruit belongs to the whole family of the leguminosæ, of which it forms the principal character. For example, in the pea, the bean, the kidney bean, &c. (See Pl. 8. fig. 3.)

The pod is naturally one-celled, but it is sometimes divided into two or more cells by false dissepiments. Thus, it is bilocular in the astragulus.

In the cassias, the pod is divided into a considerable number of cells by transverse partitions. This character belongs to the whole of the genus cassia.

The pod appears to be sometimes formed of jointed pieces. It is then said to be lomentaceous, as in the genus hippocrepis, hedysarum, &c. At other times, the pod is inflated, vesicular, and has thin and semitransparent walls, as in the bladder senna (colutea.)

The number of seeds contained in the pod varies considerably. Thus there is one in the medicago lupulina, two in the true species of ervum, &c. The pod is sometimes perfectly indehiscent, as in the cassia fistula, and other spe-

cies of the same genus; but these varieties are rare, and do not destroy the proper character of this species of fruits.

5°. The pyxidium is a dry capsular fruit, usually globular and opening by a transverse fissure into two hemispherical valves, placed the one above the other. Of this we have an example in the pimpernel, the henbane, &c. Authors usually designate it by the name of capsula circumcissa, L. (See Pl. 8. fig. 10.)

6°. The elaterium, a fruit often raised into ridges, and separating spontaneously, when ripe, into as many distinct elastic cells, which open longitudinally, as there are cavities in the fruit, as in the euphorbiaceæ. Hence, the terms tricoccum, multicoccum, given to this fruit. In general, these elastic cells are united by a central column, which is persistent after their fall.

7°. The capsule (capsula.) This general term is applied to all dry dehiscent fruits, which cannot be referred to any of the foregoing species. Hence, it is obvious, that capsules must be exceedingly variable.

Thus, there are capsules that open by pores or apertures in their upper part; such are those of the poppies, of the antirrhinum. At other times the pores are situated near the base of the capsule. Many open only at their summits, being closed by the union of small teeth, which separate

when the capsule is perfectly ripe. Of this we have examples in many genera of the family of the caryophylleæ. (See Pl. 8. fig. 4.)

SECTION II.

FLESHY FRUITS.

Fleshy fruits are indehiscent. Their pericarp is thick and pulpy; they contain a variable number of seeds. Their principal species are:

1°. The drupe (drupa,) is a fleshy fruit, containing a nut. This nut is formed by the hardened and ossified endocarp, to which is added a portion of the sarcocarp of greater or less density, as for example, in the peach, the plum, the cherry, &c. (See Pl. 8. fig. 8.)

2°. The nut differs from the drupe only in the thickness of its sarcocarp, which is very inconsiderable, and which then takes the name of shell (naucum.) Such is the fruit of the almond, (amygdalus communis,) of the wallnut (juglans regia,) which is even designated by the name of nut in ordinary language.

3°. The nuculanium is a fleshy fruit proceeding from a free ovary, that is to say, not crowned by the lobes of an adherent calyx, and containing

within it several small nuts, which bear the name nuculæ. Such are the fruits of the elder, of the ivy, of the rhamneæ, of the achras sapota.

The melonida is a fleshy fruit, proceeding from several parietal ovaries, united, and adhering to the tube of the calyx, which being often very thick and fleshy, is confounded with them, as in the pear, the apple, the medlar, the rose, &c. (See Pl. 8. fig. 9.)

In the melonida, the really fleshy part of the fruit is not composed of the pericarp itself; it is produced by a considerable thickening of the calyx, as may be easily seen by watching attentively the developement of this fruit.

The endocarp which lines each cell of the melonida, is either cartilaginous or osseous. In the latter case, there are as many nuculæ as ovaries, as in the medlar. This causes a distinction of the melonida into two varieties, namely:

The melonida containing nuculæ, whose endocarp is osseous, as in the mespilus, the cratægus.

The melonida containing pippins, whose endocarp is simply cartilaginous, as in the pear, the apple, &c.

The melonida belongs exclusively to the family of the rosaceæ, in which it is associated with some other species of fruits, which are often but varieties of it.

5°. The balausta, a many-celled, many-seeded

fruit, always proceeding from a truly inferior ovary, and crowned with the teeth of the calyx, like that of the pomegranate, and of all the true myrtles.

6°. The peponida, a fleshy, indehiscent, or ruptile fruit, with many cells scattered through the pulp, each containing a seed, which is so united with the internal parietal membrane of each cell, that it is difficult to separate them. Of this fruit we have an example in the melon, the potiron, and the other cucurbitaceæ, in the nympheaceæ and hydrocharideæ.

It sometimes happens that the fleshy parenchyma which occupies the centre of the peponida, bursts, and is lacerated by the rapid growth of the pericarp. In this case the central part is occupied by an irregular cavity, which has been erroneously considered as a true cell. This may be observed particularly in the squash gourd (pepo macrocarpus.) But on close examination, it will be seen that the pretended cell is not lined by an endocarp, which clearly shews that the cavity is only accidental, and does not constitute a true cell. In fact, it does not exist in all the species; and when it does appear, it is only towards the time of maturity.

In the pasteque or water melon (cucurbita citrullus,) may be seen the true organization of the peponida. In this species, the central part

remains full and fleshy at all periods of its developement. Each seed is contained in a distinct cell, with whose parietes it is connected only by its hilum. In this case it should seem as if nature, which, in almost all the other species of the family, has more or less altered and modified the true structure of this fruit, intended as it were to spare one of them, in order to shew the natural and primitive type of the others.

7°. The hesperidium, a fleshy fruit, with very thick integuments, and divided within into several cells by membranous partitions, which may be separated without laceration, as in the orange, the lemon, &c.

8°. The berry (bacca,) under this general name are included all fleshy fruits without a nut, which do not belong to the preceding species. Such, for example, are the fruits of the vine, the gooseberry, the love apple, &c.

SECOND CLASS.

OF MULTIPLE FRUITS.*

Multiple fruits are those that result from the union of several pistils contained within the same flower.

The syncarpium, a multiple fruit proceeding from several ovaries belonging to the same flower, and united together even before fecundation. For example, those of the magnolia, of the anona, &c.

The fruit of the strawberry, of the raspberry, is formed of a more or less considerable number of true small drupes, whose sarcocarp is very thin, but yet very manifest in the raspberry, and united on a fleshy gynophorum, which is more or less developed.

Several small acheniums united compose the fruit of the ranunculus, &c.

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* To this class really belongs the melonida, which we have placed in the former class, only in conformity with the general usage.

THIRD CLASS.

OF AGGREGATE OR COMPOUND FRUITS.

This name is given to those which are formed of a more or less considerable number of small fruits set close together, and often united, all proceeding from flowers which were originally distinct, but which are ultimately united. Such are:

The cone or strobile (conus, strobilus,) a fruit composed of a great number of membranous utricles, concealed in the axillæ of large dry bracteas, which are disposed in the form of a cone. Such is the fruit of the pines, of the alder, of the birch, &c.

The sorosis. M. Mirbel gives this name to the union of several fruits formed into a single body by the means of their floral integuments, which are fleshy, highly developed, and so intermixed with the fruits as to give the whole the appearance of a tuberculated berry. Such are the fruits of the mulberry, of the ananas (the pine apple.)

The syconium. By this name Mirbel designates the fruit of the fig tree, of the ambora, of the dorstenia. It is formed of a monophyllous involucre, which is fleshy within, and of a flat or

of an ovate and closed form, containing a great number of little drupes, which proceed from so many female flowers.

In the five and twenty species of fruits, of which we have now given a brief description, are contained nearly all the types, to which may be referred all the species of fruits which are produced by vegetables. But this view of them is not by any means complete. This part of botany still requires to be carefully cultivated, to undergo a strict analysis, before it arrives at a due degree of perfection. Our intention here is to present such species only as are well known and accurately defined, in order to avoid introducing any uncertainty or obscurity into a subject, which is of itself extremely difficult.

In order to conclude what relates to the organs of fructification, we have still to speak of the dispersion of seeds, and of the different advantages that medicine, the arts, and domestic economy may derive from fruits, and the different parts that compose them.

CHAPTER V.

OF DISSEMINATION.

When a fruit is perfectly ripe it opens; the different parts that compose it are disunited, and

the seeds which it contains soon break the ties that retained them in the cells of the pericarp. This act, whereby the seeds are naturally scattered over the surface of the earth at the period of their developement, receives the name of dissemination.

The natural dissemination of seeds is, in the wild state of vegetables, the most powerful cause of their reproduction. In fact, if the seeds contained in a fruit did not escape from it to be scattered over the earth, in order to germinate, several species would soon perish and entire families would disappear; and as all vegetables have a determinate duration, a period would arrive when they must all cease to live, and when vegetation would for ever disappear from the surface of the globe.

The time of dissemination marks the conclusion of the annual life of the vegetable. In fact, in order that it should happen, the fruit must have arrived at maturity, and be more or less dried. Now in annuals, this cannot happen until their vegetation has wholly ceased. In ligneous vegetables dissemination always takes place during their period of repose, when their liber is exhausted in giving birth to the leaves and to the organs of fructification.

The fecundity of plants, that is to say, the astonishing number of germs and of seeds pro-

by them, is not one of the least powerful causes of their easy reproduction, and of their prodigious multiplication. Ray has reckoned 32,000 seeds on a plant of poppy, and 360,000 on a plant of tobacco. Now, let us imagine the constantly increasing progression of this number, only for ten generations of these vegetables, and it will be difficult to conceive that the whole surface of the earth would not be covered by them.

But many causes tend in some degree to neutralise this surprising fecundity, which by its very excess would soon injure the reproduction of vegetables. In fact, all seeds are not placed in a situation favourable to their growth and developement. Besides, many species of animals, and man himself, deriving their chief sustenance from fruits and seeds, destroy an immense quantiity of them.

Many circumstances favour the natural dissemination of seeds. Some of these are inherent in the pericarp, others depend on the seeds themselves. Thus, there are pericarps that naturally open with a kind of elasticity, by means of which their seeds are scattered to more or less considerable distances. The fruits of the sand box tree (hura crepitans,) of the dionæa muscipula, of the fraxinella, of the balsam, rapidly disjoint their valves, as it were by a spring, and project their seeds to a considerable distance. The fruit of

the ecballium elaterium, when ripe, is detached from its peduncle, and by the scar left at its point of attachment, scatters its seeds with astonishing rapidity.

A great number of seeds are so thin and so light, as to be easily carried by the winds. Others are provided with certain appendages like wings or crowns, which make them specifically lighter by increasing their extent of surface. Thus the maples, the elms, and a great number of the coniferæ, have fruits furnished with membranous wings, which serve to transport them by the wind to considerable distances.

Most of the fruits of the vast family of the synanthereæ are crowned with a pappus, whose delicate bristles, when separated by desiccation, serve them as a parachute to support them in the air. It is the same in the valerians.

The wind sometimes conveys the seeds of certain plants to almost inconceivable distances. The erigeron canadense overruns and lays waste all the plains of Europe. Linnæus thought that the plant had been transported from America by the winds.

The river and sea waters also serve for the distant emigration of certain vegetables. Thus, there are sometimes found on the coasts of Norway and Finland fruits of the new world, which were conveyed by the waters of the ocean.

Man, and the different animals, are also a means of dissemination for seeds. Some of them become attached to their clothes or to their fleeces, by means of hooks with which nature has provided them, such as those of cleavers, of the agrimony; others serving them for food, are conveyed into the places which they inhabit, and are developed when left there, and placed in a favourable situation.

Of the Uses of Fruits and of Seeds.

In the fruits, and particularly in the seeds of a great many vegetables, are contained the alimentary substances which most abound in nutritious principles, and often medicines possessed of very energetic properties. The family of the grasses is unquestionably one of those that supply man with the greatest quantity of food, and animals with their most usual sustenance. In fact, who is not acquainted with the use which is made of bread by the civilized nations of Europe, and of the other parts of the globe? Now this excellent aliment is prepared from the farinaceous albumen of the wheat, of the barley, and of a great number of other grasses. On this account alone, this single family is to man one of the most interesting of the vegetable kingdom. The pericarps of a great many fruits furnish an aliment

which is both agreeable and useful. Every one knows the use which is made in domestic economy of a great number of fleshy fruits, such as peaches, apples, melons, strawberries, gooseberries, &c.

The fleshy pericarp of the olive (olea europæa,) yields an oil which is very pure, and held in the greatest esteem.

Wine is prepared from the juice obtained by pressure from the fruits of the vine, by subjecting it to vinous fermentation. This beverage is useful to man when taken in moderate quantities. Several other fruits, such as apples, pears, &c. also yield fermented liquors, which serve as the ordinary beverage of whole provinces and nations.

Within the pericarps of several leguminous vegetables is found an acidulous or sweetish substance, which is sometimes nauseous and has laxative properties, as in the cassia, the tamarind, the St. John's bread, the pods of senna, &c.

Dates, figs, jujubes and raisins, are alimentary substances, remarkable for containing a great quantity of saccharine principle.

The fruits of the orange and lemon trees contain citric acid nearly in a state of purity.

The small berries of the buckthorn (rhamnus catharticus,) are very purgative.

Seeds abound as much in nutritive principles as the pericarps. In fact those of the grasses, of

the leguminous plants, &c. contain a considerable quantity of amylaceous fecula, which renders them very nutritious.

The seeds of flax, of the quince tree, of the plantagò psyllium, contain a great quantity of mucilaginous principle. Accordingly, they are essentially emollient. A great many seeds are distinguished by a very aromatic stimulant principle. Such are those of anise, fennel, coriander and caraway, which have received the name of carminative seeds. Others, on the contrary, are called frigid, on account of their emollient and sedative effects on the animal economy; such are those of the bottle gourd (cucurbitala genaria,) of cucumber (cucumis sativus,) of the melon (cucumis melo,) of the water melon (cucurbita citrullus.)

All the carminative seeds belong to the family of the umbelliferæ. The family of the cucurbitacæ is that which furnishes the cold seeds.

Who is not acquainted with the constant use that all civilized nations make of the roasted seeds of coffee and of cocoa, &c. ?

From the seeds of the almond, of the walnut, of the beech, of the palma christi, of the hemp, of the poppy, of the colza, &c. is extracted a large quantity of fixed oil, whose properties are modified in each of these vegetables by its mixture with other principles.

The seeds of the bixa orellana are used for dying a reddish brown.

We could never end if we wished to enumerate all the advantages that man may derive from fruits in general, or from the parts that compose them; but to do so would be inconsistent with our object. We have only intended briefly to point out the numerous uses of fruits and seeds, both in domestic economy and in the treatment of disease.

Here we conclude that part of botany which we have designated by the name of organography. In it we have given a description of all the organs of phanerogamic vegetables, and of the functions which they perform. We shall next make known the different methods of classification which have been proposed for the arrangement of the immense number of vegetables already known and described by different authors. This part of botany is known by the name of *Taxonomy*.

OF

TAXONOMY,

OR

OF BOTANICAL CLASSIFICATIONS IN GENERAL.

We have already seen that by the name of taxonomy is designated that part of general botany whose object is the application of the laws of classification to the vegetable kingdom.

When the sciences were as yet only in their infancy, that is to say, when a small number of facts constituted their entire dominion, those who were engaged in their cultivation required no great effort, a happy memory alone being sufficient in order to possess a perfect knowledge of, and to retain the names of the objects about which those sciences were conversant. Accordingly, the first philosophers who engaged in the study of vegetables speak of them without adopting any order, or any method of arrangement.

In the time of Theophrastus, for example, who was the first that wrote a particular treatise on vegetables, the functions of the organs were mis-

taken, the genera and species were wholly confounded, and their distinctive characters unknown; in a word, although we may say that this philosopher began to write on botany, it may be also said that the science did not exist in his day. The characters of plants rested either upon empirical knowledge or upon simple tradition; for their number was so limited that it was easy to know them all individually, without the necessity of distinguishing them otherwise than by assigning a particular name to each, to which, however, no idea was annexed, either of character or of comparison. Such was the state of botany for several centuries, during which, as being intimately connected with medicine, it was admitted only into the works of those who wrote upon that science. But when by well directed inquiries and travelling to distant countries, the number of objects treated of in natural history became greater, men began to feel the necessity of using more precision in naming them, and of distinguishing them by some characters, that they might be recognised more easily. In a short time, memory alone was incapable of retaining so great a number of beings, which, for the most part, were new, and before that period unknown. It was then that men began to feel the necessity of arranging those objects in some particular order, that might facilitate their study, by affording a sure and concise method

of arriving at the name that had been given to each of them.

But these arrangements, which at first were purely empirical, are not to be looked upon as true methods. In fact they were not at all founded on a knowledge of the characters belonging to each of those beings, so as to be useful in distinguishing them from each other; but they rested solely upon some external circumstances, which were often foreign to the nature of the objects themselves. Thus the alphabetical order in which vegetables were arranged could be of no use to any except those who already knew them, and who wished to make particular inquiries respecting some of them. It is the same with respect to arrangements founded on their uses in medicine, or in domestic economy, which always suppose a previous knowledge of the virtues of the plant of which it is proposed to find out the name.

It is easy to perceive that classifications founded on such a basis must have been very defective, because in general they rested upon knowledge, which was foreign to the nature and to the organization of vegetables. They could not, therefore, give any satisfactory idea of them.

Experience, however, soon shewed the necessity of drawing from the vegetables themselves, and from the parts that compose them, the characters by which they should be made known and distin-

guished. It was from this period that botany became really a science; for it was then began the study of vegetable organization, in order to derive from thence the characters by which vegetables should be made known and distinguished.

After that period methods were really invented. But as the number of the organs of vegetables is very considerable, the number of methods were equally great; for each author supposed he discovered in some particular organ the most solid basis of an useful classification. Thus, some founded their methods on the root and its different modifications, others on the stem; some, like Sauvage, founded their systems on the leaves, and others on the inflorescence, &c.

In the sixteenth century Gessner, who was born at Zurich, was the first to demonstrate that characters taken from the flower and from the fruit, were the most certain and the most important for the purpose of establishing a good classification of vegetables. He also shewed that there are in vegetables groups composed of several species united by common characters. This first idea of uniting vegetables into genera had the greatest influence on the ulterior progress of botany.

Shortly after, Cæsalpinus, who was born in 1519 at Arezzo in Tuscany, gave the model of the first botanical method. In fact, all the species are arranged in it from a consideration of charac-

ters derived from most of the organs of vegetables, such as their duration, the presence or absence of the flowers, the position of the seeds, their adhesion to the calyx, the number and situation of the cotyledons, &c. The invention of such a method, however imperfect it may have been, must be considered as the first step towards the construction of a natural classification.

But yet new discoveries were always increasing the number of known vegetables, so that every day the existing works became more imperfect. Many authors, of whom we may particularly mention, the two brothers the Bauhini, Ray, Magnolius and Rivinus, gave successively in their writings proofs of a very rare merit; some of them even invented new methods, which, however, were all eclipsed by that of Joseph Pitton de Tournefort, which was published towards the end of the seventeenth century.

This celebrated botanist, one of those whose writings have done the greatest honour to France, was born at Aix in Provence, on the 8th of June, 656. He was Professor of Botany to the Garden of Plants at Paris, in the reign of Louis XIV., who in 1700 appointed him to an important mission to the Levant.

During this mission Tournefort travelled over all Greece, the banks of the Black Sea, and the islands of the Archipelago. He returned to Paris and

published the account of his travels, which may be mentioned as one of the most perfect models of its kind. Before his departure he had already made known in his work, entitled Institutiones rei Herbariæ, his new method, in which are described 10146 species referred to 698 genera.

The merit of Tournefort consists not only in having invented a new and ingenious method, in which are described and arranged all the plants known in his day; but his chief title to glory is to have been the first who distinguished, in a more precise and accurate manner than had been done before him, the genera and the species with their varieties.

Before him, in fact, the science was in a state of confusion and disorder; each species was not clearly distinguished from those that resembled it. It was he that reduced this chaos to order, that separated the genera and species by characteristic phrases, and, by means of his ingenious system, arranged methodically the plants which were known at that period.

After Tournefort appeared many other botanists who enjoyed a certain degree of reputation. Some of them proposed new methods; but not one of them could be placed in competition with that of Tournefort. This glory was reserved for the immortal Linnæus. His system, which he published in 1734 acquired the most extraordinary

celebrity, on account of its extreme simplicity, and of the singular facility which it affords in arriving at a knowledge of the name of a plant. Linnæus had moreover the glory of reforming, or rather of creating, the botanical nomenclature and synonymes, which had been greatly neglected by his predecessors. Tournefort had traced out the way for him, without, however, removing all the obstacles. In fact, each species was still named by a characteristic phrase, which very often did not contain the characters fit to distinguish it. Now as these phrases were very long, it was very difficult to retain many of them. Linnæus gave to each group or genus a proper name, following, in this respect, the example of Tournefort; and, moreover, he designated each species of these genera by a specific name, placed after the generic name. By this ingenious contrivance he greatly simplified the study of botany, which was already very extensive.

The sexual system of Linnæus, seductive by its simplicity, produced a sudden revolution in the science, and was received every where with the most extraordinary enthusiasm.

When the first feeling of the admiration which is always excited by a great discovery was over, it was soon perceived that this ingenious system was attended with some inconveniences, and was not by any means free from reproach. In fact, being

founded exclusively on the absolute consideration of a single organ, it often separated plants, which appeared from all their other characters to be too nearly related to admit of ever being disunited successfully; for already botanists began to perceive that many genera of vegetables have so many points of contact and of resemblance to each other, that being united by the whole of their characters, they appear, in some respect, to be all members of the same family. It was thus, for instance, that they had already united into distinct tribes, the grasses, the labiatæ, the umbelliferæ, the leguminosæ, the cruciferæ, &c. with many other groups which are equally natural. It appeared, therefore, to be a great defect in the artificial system of Linnæus to have separated vegetables which ought always to remain united. Thus the grasses are found to be dispersed over the 1st, 2d, 3rd, 6th, 21st and 23d classes of his system. The labiatæ are partly in the second and partly in the fourteenth. It was the same with most of the natural tribes already recognised and retained by a great many botanists. Linnæus being obliged to adhere strictly to his system, was, therefore, compelled to separate and to disperse them.

A new method which, by preserving the affinities of certain plants that had been already established, would have thereby exhibited the whole of

their distinctive characters, should, therefore, be preferred to this system, which, indeed, was very ingenious, but which offended in one of the most essential points.

Adanson had given the first sketch of this method. Bernard de Jussieu pursued the subject for forty years, in order to discover the most solid and permanent characters to serve as a basis for such a system. But it was his nephew Antoine Laurent de Jussieu, who, by collecting the rich materials prepared by his uncle, and adding to them numerous observations of his own, really created the method of natural families, such as we shall soon present it to our readers. It was in his Genera Plantarum, a work which is stamped with the seal of genius, and one of the finest monuments of the progress of botany, that he laid the foundation of a method which must be hereafter the only one adopted and followed by every man of sound judgment, and of good taste; for it is unquestionably, of all those that have been yet published, that which deserves the preference.

In fact, it is founded not on the consideration of a single organ; but it regards the whole of the characters furnished by all the organs of a vegetable, and unites all those which have the greatest number of points of contact and of resemblance. It is this method that has for the last forty years enabled botany to make such rapid progress, as to

place it in the first rank among the natural sciences.

We have thought it proper to enter into some details respecting methods in general, before we explain any of them in particular. It has appeared to us useful to take a rapid view of the principal epochs in the history of botany, in order to shew more clearly the impulse given to the science by each in particular of the three classifications of Tournefort, Linnæus and Jussieu, and the changes produced in it by each.

In concluding these general considerations, it it will be necessary to remark that there are two very distinct species of classifications in natural history. The one has for its basis only the consideration of a single organ. Thus, Tournefort has employed the corolla, and Linnæus the stamina for establishing their principal divisions. These purely artificial arrangements have received the name of systems. It is clear that a system, having for its object only to facilitate the discovery of the name of a plant, gives no idea of its organization. Thus, when we have found that a plant is of the first class of the Linnæan system, or of that of Tournefort, all we know is, that in the first case it has a single stamen, and, in the second, that its corolla is monopetalous, regular, and bell-shaped. But these systems teach us nothing respecting the other parts that compose

the plant, of which they barely make known the name. In the second species of classification, which has received the name of method, properly so called, as each class is founded on the sum total of all the characters taken from the different parts of the vegetable, when we arrive at one of these classes we are already acquainted with all the most striking points of the organization of the vegetable whose name we wish to know. If, for instance, by means of analysis, we come to know that such a plant is, I shall suppose, of the fourth class of Jussieu, by this we know that the plant is phanerogamic, that its embryo has but one floral integument, that is to say a monosepalous calyx adhering to an inferior ovary, that its stamina are inserted on the ovary, &c. By this we may perceive that the study of natural families gives more precise and philosophical ideas respecting the structure and organization of the different vegetables. It, therefore, very justly deserves to be preferred to all those that had been previously invented.

It would be both tedious and useless to enter here into an explanation of all the methods that have been proposed by different botanists, for the purpose of grouping and arranging all known vegetables into classes. Besides, their number is so great, that we could not give even a brief account of them, except in a work that was written

expressly for that purpose. Accordingly, we shall here be content with explaining the three most important classifications, which are those of Tournefort, Linnæus, and Jussieu.

OF THE METHOD OF TOURNEFORT.

The system of Tournefort, generally known by the name of Tournefort's method, is founded chiefly on the consideration of the different forms of the corolla. Tournefort is generally reproached with not having followed the example already set by Rivinus, but to have again separated the herbaceous vegetables from those that have a woody stem. This is a very great inconvenience, because these two modifications of the stem are often united in the same genus, and even sometimes, as we have already proved, particular circumstances may act so powerfully on one and the same species, as to make it at one time woody, at another herbaceous. This is what we have remarked with respect to the palma christi, the marvel of Peru, &c.

This system is composed of two-and-twenty classes, whose characters are taken: 1°. from the consistence and magnitude of the stem; 2°. from the presence or absence of the corolla; 3°. from

the separation of the flowers, or from their union in a common involucre; 4°. from the integrity of the corolla, or from its division into distinct segments, that is to say, from the consideration of the monopetalous or polypetalous corolla; 5°. from its being regular or irregular.

1°. With respect to the duration and consistence of the stem, Tournefort divides vegetables into herbs, undershrubs, arbuscles and trees. The herbs and undershrubs together, are contained in the first seventeen classes; the five latter classes contain the arbuscles and trees.

2°. From the presence or absence of the corolla, herbs are divided into the petalous and apetalous. The first fourteen classes of herbs contain all those which are provided with a corolla; the other three contain those which have none.

3°. Herbs which have a corolla have their flowers either separated and distinct, or united so as to form compound flowers. The first eleven classes contain the herbs whose flowers are simple; the three following contain those with compound flowers.

4°. Among the herbaceous plants with simple flowers, some have a monopetalous corolla; in others, on the contrary, it is polypetalous. In the four first classes, Tournefort has united the plants which have a monopetalous corolla; the

five following contain those whose corolla is polypetalous.

5°. But this monopetalous or polypetalous corolla may be regular or irregular; this has served for subdividing each of these sections.

Plants which have a woody stem, are contained, as we have already observed, in the five last classes of the system. Tournefort has divided them according to the same principles as the herbaceous plants. Thus they are apetalous or petalous; their corolla is monopetalous or polypetalous, regular or irregular.

It is important to observe, that Tournefort called the simple and coloured perianths a corolla; such are those of the tulip, of the lily, which according to him have a polypetalous regular corolla.

Such are the principles which have directed Tournefort in the formation of the classes of his system, of whose characters we shall give a summary view to our readers.

FIRST DIVISION.

HERBS.

§. 1. WITH SIMPLE FLOWERS.

Corolla monopetalous regular.

First Class.

Campaniformes. Herbs with a monopetalous regular corolla resembling a bell, as in the campanula, convolvulus, &c., or like a small bell, as in the lily of the valley, the heath, &c. (See Pl. 5. fig. 3, 4.)

Second Class.

Infundibuliformes. Herbs with a monopetalous regular corolla, having the form of a funnel, as the tobacco; that of an antique cup, that is to say, hypocrateriform, as the lilach; or of a wheel (cor. rotata,) as the borage. (See Pl. 5. fig. 1, 2.)

Third Class.

Corolla monopetalous irregular.

Personatæ. Corolla monopetalous irregular, having the form of a calf's snout, or of an antique mask,

like that of the antirrhinums, &c.; or having the border more or less open, as in the fox-glove, the fig-wort.—Plants of this class have always a simple ovary at the bottom of the calyx. (See Pl. 5. fig. 7.)

Corolla monopetalous irregular.

Fourth Class.

Labiatæ. Corolla monopetalous irregular, whose border is two-lipped; they divide into four very distinct lobes, which are considered as naked seeds. Such are the sage, the rosemary, the betony, the thyme, &c. (See Pl. 5. fig. 8.)

Fifth Class.

Corolla polypetalous regular.

Cruciformes. Corolla polypetalous regular, composed of four petals disposed in the form of a cross. The fruit is a silique or a silicule. Ex: the wall flower, the cabbage, the shepherd's purse. (See Pl. 5. fig. 9.)

Sixth Class.

Rosaceæ. Corolla polypetalous regular, composed of petals varying from three to ten, disposed like those

Corolla polypetalous regular, continued.

of a rose, as in the pear tree, the apple tree, the wild rose, the strawberry, the raspberry, the cistus, &c. (See Pl. 5. fig. 11.)

Seventh Class.

Umbelliferæ. Corolla polypetalous regular, composed of five petals, which are often unequal, with the flowers disposed in an umbel. Ex: angelica, parsnip, fennel, &c.

Eighth Class.

Caryophylleæ. Corolla polypetalous regular, formed of five petals with long claws, united in a monosepalous calyx; limb spreading; for example, the pink, the soap wort, the cockle, and in general all the caryophylleæ. (See Pl. 5. fig. 10.)

Ninth Class.

Liliaceæ. Flowers with a corolla usually polypetalous, composed of six or only of three petals; sometimes monopetalous with six divisions; the fruit is a three-celled capsule or berry. Ex: the lily, the tulip, the hyacinth, &c.

Tenth Class.

Corolla polypetalous irregular.

PAPILIONACEÆ, or LEGUMINOSÆ. Corolla polypetalous irregular, composed of five petals, the upper called standard, the two lateral called wings, and the two lower sometimes united and constituting the keel. Ex: the pea, the kidney bean, &c. The fruit is always a pod. (See Pl. 9. fig. 12.)

Eleventh Class.

ANOMALÆ. This class contains all the herbaceous plants, whose corolla is polypetalous irregular, but not papilionaceous; such are the violet, the nasturtium, &c.

§ 2. COMPOUND FLOWERS.

Twelfth Class.

Compound flowers.

FLOSCULOSÆ. Flowers composed of small, monopetalous, regular funnel-shaped corollas, with a border cleft into five divisions. Each of these small flowers has received the name of floret. Such are the cardoons, the artichokes, the thistles, &c. (See Pl. 5. fig. 5.)

Com-
pound
flowers
con-
tinued.

Thirteenth Class.

Semiflosculosæ. Flowers composed of a great number of small monopetalous, irregular corollas, whose border is turned down on one side, and which have received the name of semiflorets. Ex: lettuce, the salsify, the dandelion, &c. (See Pl. 5. fig. 6.)

Fourteenth Class.

Radiatæ. Flowers composed of florets in the centre, and of semiflorets in the margin, as in the great sunflower, the daisy, &c.

§ 3. Apetalous Plants.

Apeta-
lous.

Fifteenth Class.

Apetalæ. Plants whose flowers have not a true corolla, as the grasses, the rice, the barley, the wheat, the oat, &c. In some there is around the sexual organs a simple perianth or calyx, which often continues after flowering, and grows with the fruit, as in the rumex.

Sixteenth Class.

Apetalæ without flowers. Plants which have neither sexual organs nor

Apetalous.

floral integuments, properly so called; but which have leaves. These are the ferns, such as the polypodium, the ceterach, the osmunda, &c.

Seventeenth Class.

Apetalæ, without flowers or visible fruits, as the fungi, the musci, lichens, &c.

SECOND DIVISION.

TREES.

Apetalous.

Eighteenth Class.

Apetalous trees or shrubs; that is to say, whose flowers have no corolla. These trees are either hermaphrodite or diœcious, as the box, many of the coniferæ, &c.; or diœcious, like the pistacia lentiscus.

Nineteenth Class.

Amentaceæ. Apetalous trees whose flowers are disposed in catkins. They are monœcious, as the oak, the wallnut, &c.; or diœcious like the willows, &c.

Monopetalous.

Twentieth Class.

Trees with a monopetalous regular or irregular corolla, such as the lilach, the elder, the catalpa, the arbutus, &c.

Polypetalous regular.

Twenty-first Class.

Trees or shrubs having a polypetalous, rosaceous corolla, such as the apple tree, the pear tree, the orange tree, the cherry tree, &c.

Polypetalous irregular.

Twenty-second Class.

Trees or shrubs whose corolla is papilionaceous, as in the acacia, &c.

Such are the two-and-twenty classes established by Tournefort for the arrangement of all known vegetables. Although, at first view, this system appear simple and easily reducible to practice, yet, in most cases, it is attended with difficulties which are not easily removed. In fact, the form of the corolla is not always so distinct as that we can, in every instance, say at once to which class it belongs; for where is the exact line of demarcation between an hypocrateriform corolla, and that which is funnel-shaped; or between the latter and the campanulate corolla?

The best founded objection that can be made to this system is, that it separates herbaceous from woody vegetables. In fact, the most natural affinities are thereby mistaken, and vegetables which have the greatest resemblance to each other are often separated and thrown at considerable distances asunder, on account of this difference only.

Each of these classes has been divided into a more or less considerable number of sections or orders, whose characters have been taken from the peculiar modifications in the form of the corolla; from the consistence, composition, and origin of the fruit; from the form, disposition, and composition of the leaves, &c.

Lastly, each of these sections contains a more or less considerable number of genera, which contain all the species known in the time of Tournefort.

A KEY TO THE METHOD OF TOURNEFORT.

					Classes.
HERBS.	Petalous.	Simple.	Monopetalous.	Regular.	1. Campaniform.
					2. Infundibuliform.
				Irregular.	3. Personate.
					4. Labiate.
			Polypetalous.	Regular.	5. Cruciform.
					6. Rosaceous.
					7. Umbelliferous.
					8. Caryophylleous.
					9. Liliaceous.
				Irregular.	10. Papilionaceous.
					11. Anomalous.
		Compound.			12. Flosculous.
					13. Semi-flosculous.
					14. Radiated.
	Apetalous.				15. Staminiferous.
					16. Without flowers.
					17. Without either flowers or fruits.
TREES.	Apetalous.				18. Apetalous, properly so called.
					19. Amentaceous.
	Petalous.		Monopetalous.		20. Monopetalous.
			Polypetalous.	Regular.	21. Rosaceous.
				Irregular.	22. Papilionaceous.

OF THE SEXUAL SYSTEM OF LINNÆUS.

The foundation of the Sexual System of Linnæus rests almost exclusively on the different characters taken from the male sexual organs, that is to say, from the stamina; in the same manner as that of Tournefort is founded on the different forms of the corolla. This system is divided into four-and-twenty classes.

Linnæus first divides all the known vegetables into two great sections. In the first he places all those that have sexual organs, and therefore visible flowers. These are called phanerogamic or phenogamic. The second section includes the vegetables in which the sexual organs are concealed, or rather which are wholly destitute of them; they are called cryptogamic. Hence the two first great sections of the vegetable kingdom.

1°. The phanerogamics.

2°. The cryptogamics.

But as the number of the vegetables of the first section is infinitely greater than that of the second, the phanerogamics have been divided into three-and-twenty classes; the cryptogamics, on the contrary, form but the twenty-fourth or last class of the system.

Amongst phanerogamic plants, some have

hermaphrodite flowers, that is to say, in which both the sexes are united; others are unisexual.

The first twenty classes of the sexual system contain the phanerogamic vegetables with hermaphrodite or monoclinous flowers; in the three following are placed the diclinous or unisexual flowers.

3°. Phanerogamic. { Monoclinous.
Diclinous.

The monoclinous plants either have the stamina free and detached from the pistil, or else they are united with it.

4°. Monoclinous, { with stamina free.
with stamina united with the pistil.

The stamina, which are free from all adhesion to the pistil, may be free and distinct from each other, or they may be united and cohere.

5°. Stamina not united with the pistil. { free and distinct.
coherent.

The free and distict stamina are equal or unequal to each other.

Those which are free and equal are of a definite or indefinite number.

6°. Free and equal stamina of { a definite number.
an indefinite number.

It is by considerations of this kind that Linnæus has laid the foundation of his system. Hence we see that it is founded, 1°. Upon the number of the stamina, (the first thirteen classes;) 2°. On their proportions to each other; (the

fourteenth and fifteenth ;) 3°. On their union by the filaments ; (sixteenth, seventeenth, and eighteenth ;) 4°. On their union by the anthers ; (the nineteenth ;) 5°. On their union with pistil ; (twentieth ;) 6°. On the separation of the sexes ; (twenty-first, twenty-second, twenty-third ;) 7°. Lastly, on the absence of sexual organs ; (the twenty-fourth and last.)

We shall now, in succession, consider the characters of these different classes, which have each received a particular name.

1°. *The Stamina of a definite Number, and equal to each other.*

First Class. Monandria. It contains all the plants whose flowers have but one stamen : the hippuris vulgaris, the blitum, the canna indica, &c.

2nd Class. Diandria. Two stamina : the jasmin, the lilach, the veronica, the sage, the rosemary, &c.

3rd Class. Triandria. Three stamina : most of the grasses, the iris, &c.

4th Class. Tetrandria. Four stamina : the madder, the bedstraw, the woodruff, the scabious, &c.

5th Class. Pentandria. Five stamina : the boragineæ, such as the borage, the lungwort ; the

solaneæ, such as the dulcamara, the belladonna, the potato, the winter cherry, &c.; the exotic rubiaceæ, such as cinchona, psychotria, &c.; the umbelliferæ, such as the parsnip, the hemlock, the opoponax, the coriander, &c.

6th Class. Hexandria. Six stamina: such are most of the liliaceæ, the lily, the tulip, the hyacinth; many of the asparagineæ, as the asparagus, the lily of the valley, &c.; the rice.

7th Class. Heptandria. Seven stamina. This class contains but few vegetables. We find in it the horse chesnut, the lizard's tail, &c.

8th Class. Eight stamina: the polygonum, the heaths.

9th Class. Enneandria. Nine stamina. To this class are referred the different species of laurel, of rhubarbs; the butomus umbellatus, &c.

10th Class. Decandria. Ten Stamina. We here find almost all the caryophylleæ, such as the pink, the lychnis, the silene, the rue, the phytolacca decandra, &c.

2°. *The Number of Stamina not exactly determined.*

11th Class. Dodecandria. From eleven to twenty stamina. Examples: the asarum Europæum, the reseda; the agrimony, the sempervivum tectorum, &c.

12th Class. Icosandria. More than twenty stamina inserted on the calyx. In this class are found all the true rosaceæ; the plum tree, the almond tree, the rose tree, the strawberry, &c.; the myrtle, the pomgranate, &c.

13th Class. Polyandria. From twenty to one hundred stamina inserted under the ovary. In this class are contained the true ranunculaceæ, such as the anemones, the clematis, the ranunculus, the hellebore, &c.; most of the papaveraceæ, such as the common red poppy, the chelidonium, &c.

3°. *The Proportion of the Stamina to each other.*

14th Class. Didynamia. Four stamina, of which two are always shorter, and two longer, all inserted on an irregular monopetalous corolla. This class contains the labiatæ and personatæ of Tournefort, such as thyme, lavender, bugle, betony, antirrhinum, digitalis, scrophularia, the catalpa, &c.

15th Class. Tetradynamia. Six stamina, of which two are always shorter than the other four; corolla polypetalous; fruit a siliqua or a silicula. This class perfectly corresponds with the cruciferæ of Tournefort.

4°. *Union of the Stamina by their Filaments.*

16th Class. Monadelphia. Stamina of a variable number, united into one body by their filaments. Example, the common mallow, the marsh mallow, &c.

17th Class. Diadelphia. Stamina of a variable number, united by their filaments into two distinct bodies. Such are the fumitory, the polygala, and most of the leguminous plants, as the acacia, the cytisus, the liquorice, the melilot, &c.

18th Class. Polyadelphia. Stamina united by their filaments into three or a greater number of bundles. For example, the hypericum, the orange, the melaleuca, &c.

5°. *Union of the Stamina by their Anthers.*

19th Class. Syngenesia. Five stamina united by the anthers; flowers usually compound, rarely simple. This class contains the flosculosæ, the semiflosculosæ, and the radiatæ of Tournefort; it also contains certain other plants, such as the lobelia, the violets, &c.

6°. *Union of the Pistil and Stamina.*

20th Class. Gynandria. Stamina united into one body with the pistil; such are all the orchideæ, the aristolochiæ, &c.

7°. *Flowers unisexual.*

21st Class. Monœcia. Male and female flowers distinct, but united on the same plant. Examples: the oak, the box, the Indian corn, the arrow head, the castor oil plant, &c.

22d Class. Dioecia. Male and female flowers on two separate plants: the mercurialis, the date palm, the misseltoe, the willow, the pistachia, &c.

23d Class. Polygamia. Hermaphrodite flowers, male flowers and female flowers united on the same plant, or growing on different plants. For example: the ash, the pellitory, the crosswort, &c.

8°. *Flowers invisible.*

24th Class. Cryptogamia. Plants whose flowers are invisible or very indistinct. This class contains the ferns, such as the polypodium, the osmunda, &c.; the mosses, the lichens, the equisetum, the algæ, the fungi, &c.

We have now briefly explained the characters belonging to each of the four-and-twenty classes established by Linnæus in the vegetable kingdom. We see that the course of this system is simple and easily pursued. In fact, it appears, at first

view, that nothing more is necessary than to reckon the number of stamina in each flower, in order to know to which class it belongs. But yet it may be remarked, that in many cases this determination is not so easy as might be at first supposed, and that we very often remain in doubt, particularly when the plant presents any unusual anomaly.

Let us now try to explain the considerations on which are established the orders belonging to each class.

In the first thirteen classes, whose characters are drawn from the number of the stamina, those of the orders have been taken from the number of styles or of distinct stigmas. Thus a plant of the class pentandria, such as the parsnip or any other of the umbelliferæ, which has two styles or two distinct stigmas, shall be of the second order. It should be of the third order if it had three, &c.

Let us see what are the names given to these different orders.

1st Order. Monogynia, one style.
2d Order. Digynia, two styles.
3d Order. Trigynia, three styles.
4th Order. Tetragynia, four styles.
5th Order. Pentagynia, five styles.
6th Order. Hexagynia, six styles.
7th Order. Heptagynia, seven styles.

8th Order. Decagynia, ten styles.

9th Order. Polygynia, a great number of styles.

It is necessary to remark that this whole series of orders is not observed in all the classes. In monandria, for example, there are but two orders; monogynia as in the hippuris, and digynia as in the blitum.

In tetrandria there are three orders; namely, monogynia, digynia, and tetragynia. There are six in pentandria, &c.

In the fourteenth class, Linnæus has founded the characters of the two orders it contains on the structure of the ovary. In fact, the fruit is sometimes formed of four small acheniums placed in the bottom of the calyx, and which he regarded as four naked seeds; sometimes, on the contrary, it is a capsule which contains a more or less considerable number of seeds. The first of these orders bears the name of gymnospermia (naked seeds;) it contains all the true labiatæ, such as the marrubium, the nepeta, the phlomis, the scutellaria, &c.

The second order, which is called angiospermia, (seeds in a capsule,) and which is distinguished by having a capsular fruit, contains all the personatæ of Tournefort. Such as the rhinanthus, the toadflax, the melampyrum, the broomrape, &c.

Tetradynamia, or the fifteenth class, has also

two orders, taken from the form of the fruit, which is a silique or a silicule. Hence, tetradynamia is distinguished into siliculosa, or that which contains the plants whose fruit is a silicula, such as the cochlearia, the thlaspi, &c., and into siliquosa, or that which contains the plants whose fruit is a siliqua, as the wall flower, the cabbage, the water cress, &c.

The sixteenth, seventeenth, and eighteenth classes, that is to say, monadelphia, diadelphia, and polyadelphia, have been established on the union of the filaments into one, two, or a greater number of distinct bundles, without any regard to the number of stamina that compose them. Linnæus has, in this case, employed the characters taken from the number of the stamina to form the orders of these three classes. Thus, monadelphous plants are said to be triandrous, tetrandrous, pentandrous, decandrous, polyandrous, accordingly as they contain three, four, five, ten, or a greater number of stamina united by their filaments into a single body. It is the same in diadelphia and polyadelphia, that is to say, the names of the orders are the same with those of the first classes of the system.

Syngenesia or the nineteenth class of the sexual system, is one of those that contain the greatest number of species. In fact, the synantheræ compose nearly the one-twelfth of all the

known vegetables. It was, therefore, very important to multiply its orders in order to facilitate the investigation of the different species. This is what Linnæus has tried to accomplish by dividing the class into six orders. But as here the number of stamina is almost invariably five, it could not afford a sufficiency of characters to serve as a basis for these divisions. Linnæus has, therefore, selected for that purpose the structure of the florets that form the assemblages known by the name of compound flowers. In fact, in consequence of constant abortions, those flowers contain hermaphrodite florets, male and female florets, and sometimes even such as are wholly neuter. Linnæus, whose poetical genius was remarked in all the names he gave to the different orders of his system, saw in these combinations and mixtures of flowers a species of polygamy. Accordingly, he gave that name to each of the six orders of syngenesia, adding to each a peculiar epithet. The following are their characters :

1st Order. Polygamia equalis. All the flowers are hermaphrodite, and, therefore, all equally fruitful, as may be seen in the cardoons, the salsifies, &c.

2d Order. Polygamia surperflua. The flowers of the disc are hermaphrodite ; those of the circumference are female, but both produce seeds. For example, the artemisia.

3d Order. Polygamia frustranea. The flowers of the disc are hermaphrodite and fruitful; those of the circumference are neuter or female, but barren through the imperfection of the stigma; they are, therefore, all useless; in the last order they were only superfluous. Example, the centaurea, the helianthus, &c.

4th Order. Polygamia necessaria. The flowers of the disc are hermaphrodite, but barren through a defect in the conformation of the stigma; those of the circumference are female, and fecundated by the pollen of the former. In this case they are, therefore, necessary for the preservation of the species, as in the marigold, &c.

5th Order. Polygamia separata. All the flowers are hermaphrodite, and close to each other, but yet contained each in a small proper involucre, as in the echinops.

6th Order. Polygamia monogamia. The flowers are all hermaphrodite; but they are simple and separated from each, as in the violet, the lobelia, the balsam, &c.

The latter order, as may be easily seen, has no affinity to the former. It has nothing in common with them but the union of the stamina, by their anthers.

In gynandria, or the twenty-first class of the sexual system, there are four orders which are taken from the number of the stamina. Thus we

say, gynandria monandria, as in the orchis, the ophrys; gynandria diandria, as in the cypripedium; gynandria hexandria, as in the aristolochia; gynandria, polyandria, the arum.

Monœcia and diœcia, present as it were a combination of all the modifications that we have remarked in the other classes. Thus, monœcia contains monandrous, triandrous, decandrous, polyandrous, monadelphous, and gynandrous plants. Each of these varieties serves to establish a distinct order in this class.

Diœcia contains a still greater number of orders, whose characters are the same with those of some of the classes already established.

The twenty-third class, or polygamia, which contains plants with hermaphrodite and unisexual flowers mixed, either on the same or on two or three distinct individuals, has been, on that account, divided into three orders: 1st, monœcia, in which the same individual bears monoclinous and diclinous flowers; 2dly, diœcia, in which hermaphrodite flowers are found on one individual, and unisexual flowers on the other; lastly, triœcia, in which the species is composed of three individuals, one bearing hermaphrodite flowers, another male flowers, and the third female flowers.

Cryptogamia, which forms the twenty-fourth and last class, is divided into four orders: 1°. the

the ferns; 2°. the mosses; 3°. the algæ; 4°. the fungi.

After having made known the basis of the sexual system, we have given a sketch of the four-and-twenty classes, and of the numerous orders contained in them, such as they have been established by Linnæus. When we examine this system, we are struck with its extreme simplicity and with the facility which it affords for investigating the name of a plant. The classes, in fact, are perfectly distinct and well defined, particularly those whose stamina are of a definite number. Not only does this system contain all the plants already known, but it is even capable of containing all those that may be hereafter discovered: accordingly it was universally adopted at the period of its first publication.

But after all we must confess, that it is attended with more than one great inconvenience. In fact, it is not always easy to determine positively if a plant belong to certain classes. Thus, for example, the rue (ruta graveolens,) has nearly all its flowers possessed of eight stamina; a single flower in the centre of each assemblage of flowers contains ten. The student, in this case, would be perplexed, and would be inclined to place this plant in the eighth class of the system. Yet Linnæus places it in the tenth class, as he considers the central flower the most perfect.

Neither is dodecandria characterized with sufficient precision. It contains all the plants which have from twelve to twenty stamina. But yet the agrimony which is placed in this class, has often more than twenty stamina.

Certain labiate and personate flowers, which belong to didynamia, have their four stamina equal to each other, and the irregularity of the corolla is often scarcely perceptible.

The orders of syngenesia are often extremely difficult to distinguish with certainty. Besides, the mixture of male, female, and hermaphrodite flowers, throws many of them into diœcia and polygamia.

The sixth of these orders, the polygamia monogamia, connects vegetables with the compositæ, which have no resemblance to them, such as the violets, the lobelia, the balsams, &c.

The twenty-third class, that is to say polygamia, is a confused mixture of plants, nearly all belonging to the other different classes.

If we now examine the plants assembled in each of these classes, we shall find that natural affinities, which have been long acknowledged, have been completely broken by them. Thus, one of the most natural families, the grasses, are dispersed in monandria, diandria, triandria, hexandria, monœcia, diœcia, and polygamia. The labiatæ are partly contained in diandria, partly in

didynamia. It is the same with a great number of other families which are equally natural. But as the classification established by Linnæus is a system, that is to say, an arrangement which is methodical, but yet purely artificial, and destined only to facilitate the discovery of the name of a plant, it cannot be objected to on the ground of having thus placed asunder plants which have many points of resemblance and a close affinity to each other. This is not the system that ought to be studied when we wish to know the natural relations of the different vegetables to each other; but of all the artificial systems, it unquestionably deserves the preference, as furnishing an easy means of investigating the name of a plant. Wishing to remove from this ingenious system a part of the inconveniences which we have adverted to, and to make its application in some respects more easy, my deceased father made some important alterations in it, which I shall now explain. It was according to this modified system of Linnæus, that the plants in the garden of the faculty of medicine at Paris were arranged.

The Sexual System modified.

The ten first Classes are retained without any change:

The 11th Class is polyandria, thus charac-

terized : more than ten stamina inserted under the pistil, which is either simple or multiple, that is to say, having their insertion hypogynous. This class, which is substituted for dodecandria, corresponds exactly with the polyandria of Linnæus.

The 12th Class is calycandria, and is thus characterized : more than ten stamina inserted on the calyx, the ovary being free or parietal ; the insertion perigynous. This class partly corresponds with dodecandria, partly with icosandria. It contains all the true rosaceæ.

The 13th Class is hysterandria. Its character is to have more than ten stamina inserted on a perfectly inferior ovary, the insertion being, therefore, epigynous. This class partly corresponds with icosandria. It contains the myrtles, the pomgranate, the philadelphus, the psydium, &c.

These three classes, thus characterized, are much more precise, and, at the same time, more conformable to natural affinities, than those originally established by Linnæus, whose characters, taken from the number of the stamina, might lead the student into error. The 14th Class is didynamia, whose orders designated by Linnæus by the names of gymnospermia (naked seeds) and of angiospermia (seeds in capsules) conveyed false ideas, inasmuch as there are no naked seeds. They have been replaced by the following :

1°. Tomogynia, ovary cleft and separated into

distinct lobes; style growing from a central depression of the ovary; the ripe fruit a tetrakenium. This order contains the whole of the labiatæ.

2°. Atomogynia (the ovary undivided.) The fruit capsular, many-seeded. In this class are found the antirrhinum, the bignoniaceæ, &c.

19th Class. Synantheria, replacing syngensia, is thus characterized: stamina united by the anthers only, so as to form a small tube; ovary one-seeded.

From this character we may see that the class can contain only the plants with true compound flowers, that is to say, the flosculosæ, the semi-flosculosæ, and the radiatæ of Tournefort.

The orders of the Class Syngenesia of Linnæus being taken from characters which are too minute, too difficult to recognise, and often varying in the same genus, have been changed into the following, which are easily distinguished.

1st Order. Carduaceæ. Capitulum composed of florets indifferently hermaphrodite, male or female; phoranthium furnished with very numerous bristles; style having a slight protuberance under the stigma; connective, sometimes continued above the anthers so as to form a finely toothed tube; such are the cardoons, the knapweed, &c.

2d Order. Corymbiferæ. Capitulum flosculous or radiated; phoranthium naked or covered

with scales, each of which accompanies a flower. (In the preceding order there are many at the base of each.) Example: the tussilago, the gnaphalium, the erigeron, &c.

3d Order. Chicoraceæ. Capitulum composed of semiflosculous florets. Examples, lactuca, chicorium, scorzonera, &c.

20th Class. Symphysandria. This class is formed of the sixth order of the syngenesia of Linnæus, the polygamia monogamia. Its characters are stamina united by their anthers, and sometimes even by their filaments, a many seeded ovary, simple flowers; for example, the lobeliaceæ, the violets Gynandria, monœcia, and diœcia, are retained without any change.

24th Class. Anomalœcia. Hermaphrodite or unisexual flowers on the same or on different individuals. This class corresponds to the polygamia of Linnæus.

26th Class. Agamia. Vegetables without sexual organs, and propagated by means of peculiar corpuscles called sporules, analogous to the bulbils of other plants.

Such are the changes that my father thought proper to make in the sexual system of Linnæus, in order to free it, as much as possible, from those defects which make the application of it difficult.

A KEY TO THE SEXUAL SYSTEM OF LINNÆUS.

							Classes.
PLANTS with....	Sexual organs, apparent.	Flowers hermaphrodite.	Stamina distinct from the pistil.	Free..	Proportion undetermined.	Number.	1. Monandria.
							2. Diandria.
							3. Triandria.
							4. Tetrandria.
							5. Pentandria.
							6. Hexandria.
							7. Heptandria.
							8. Octandria.
							9. Enneandria.
							10. Decandria.
							11. Docecandria.
						Number and Insertion......	12. Icosandria.
							13. Polyandria.
					Proportion determined........		14. Didynamia.
							15. Tetradynamia.
				United.............	by the filaments.		16. Monadelphia.
							17. Diadelphia.
							18. Polyadelphia.
					by the anthers.		19. Syngenesia.
			Stamina united with the pistil..................				20. Gynandria.
		Flowers unisexual....................................					21. Monœcia.
							22. Diœcia.
							23. Polygamia.
	Sexual organs concealed..						24. Cryptogamia.

Classes.

- PLANTS with....
  - Sexual organs existing.
    - All the flowers hermaphrodite.
      - Stamina separated from the pistil.
        - Free.
          - Proportion undetermined.
            - Number of stamina, without regard to insertion.........
              - One...................... 1. MONANDRIA.
              - Two...................... 2. DIANDRIA.
              - Three.................... 3. TRIANDRIA.
              - Four..................... 4. TETRANDRIA.
              - Five..................... 5. PENTANDRIA.
              - Six...................... 6. HEXANDRIA.
              - Seven.................... 7. HEPTANDRIA.
              - Eight.................... 8. OCTANDRIA.
              - Nine..................... 9. ENNEANDRIA.
              - Ten...................... 10. DECANDRIA.
            - Number of stamina, considering their insertion.........
              - More than ten inserted under the ovary............. 11. POLYANDRIA.
              - More than ten inserted on the calyx, the ovary being free or parietal.......... 12. CALYCANDRIA.
              - More than ten inserted on the calyx, the ovary being united on all sides with the tube of the calyx..... 13. HYSTERANDRIA.
          - Proportion determined..........
            - Two large and two small... 14. DIDYNAMIA.
            - Four large and two small.... 15. TETRADYNAMIA.
        - united.
          - By the anthers..............
            - Into one body............. 16. MONADELPHIA.
            - Into two bodies........... 17. DIADELPHIA.
            - Into more than two bodies... 18. POLYADELPHIA.
          - By the anthers, the ovary being one-seeded.................. 19. SYNANTHERIA.
          - By the anthers alone, or at the same time by the filaments, the ovary being many-seeded.............................. 20. SYMPHYSANDRIA.
      - Stamina united to the pistil.............................. 21. GYNANDRIA.
    - Flowers not all hermaphrodite.
      - Flowers unisexual.
        - Male and female flowers on the same individual.............. 22. MONŒCIA.
        - Male flowers and female flowers on different individuals........ 23. DIŒCIA.
      - Hermaphrodite flowers and unisexual flowers on the same, or on different individuals... 24. ANOMALŒCIA.
  - Sexual organs not existing.............................. 25. AGAMIA.

THE METHOD OF M. DE JUSSIEU,

OR

OF NATURAL FAMILIES.

The method of natural families differs essentially, in its course and in its characters, from the two systems of Tournefort and Linnæus, of which we have now given an explanation. In this method the divisions are not founded on the consideration of a single organ, but characters derived from all the parts of vegetables contribute to their formation. Accordingly, the plants which are brought together in this way, are so arranged, as to have closer affinities with those which immediately precede or follow them, than with any other.

This classification is, therefore, far superior and preferable to all those which have gone before it, on account of the general and philosophic ideas which it gives us of the productions of the vegetable kingdom. In fact, it does not consider objects as individuals; but it unites and arranges them in groups and families, according to the greatest number of their common characters.

Nature, in impressing on the physiognomy of certain vegetables a peculiar character, connected with their internal structures, seems to have designed it as a guide to botanists in their search of the affinities which exist between all vegetable productions. In fact, there is a great number of plants which have so strong a resemblance to each other in the structure and conformation of their parts, that, at all times, this analogy has been perceived, and these different vegetables have been considered as, in some respect, belonging to the same family. Thus the grasses, the labiatæ, the cruciform and syngenesious plants, have been always united, whenever the characters of natural affinity and resemblance were not sacrificed to the purposes of an artificial system.

When, therefore, botanists undertook to unite and to collect all vegetables into families, that is into groups or series of genera resembling each other in the greatest number of their characters, they had only to imitate nature, who had, as it were, created, as if for models, types of families which were essentially natural. Thus, the leguminosæ, the cruciformes, the gramineæ, the umbelliferæ, came of their own accord to exhibit themselves to the botanist, as so many examples which he should endeavour to imitate.

But as all vegetables had not, like those we have now enumerated, external characters sufficiently

precise and evident to make known at first sight their affinities to others, recourse was had to analysis, and, in the entire system of organs, such modifications were looked for as might serve for the purpose of characters.

It is in the genera plantarum of Jussieu, the true inventor of the method of natural families, that we must study the principles of this method, the spirit of which it is impossible to explain in the brief exposition which we are compelled to give of it.

We shall just endeavour to explain the manner in which characters have been viewed by this author, and the principles which serve as a basis to this admirable classification.

Characters ought to be considered in regard to their value, to their number, and to their affinity.

With respect to the value of characters, it will be readily understood, that they ought to be the more fixed and important as they are taken from the most essential organs of vegetables. Now we know that those which contribute to reproduction perform the most important office in vegetable life, and again, that of these organs, the embryo, which appears to be the end to which all the functions of the plant are directed, deserves, from its importance, to occupy the first rank. It is there-

fore in the embryo that M. de Jussieu has looked for the first foundations of his divisions.

The stamina and pistils occupy the second rank, and furnish more constant and valuable characters than the floral integuments. These characters have the greater value as they are taken, not from the number and structure of these organs, which are very liable to change, but from their relative situation, which is fixed and invariable. Thus, next to the embryo, the relative situation of the sexual organs, or their insertion, furnishes the most important character for the arrangement of vegetables.

Lastly, the stems, leaves, and roots, can be employed only for the purpose of supplying accessory characters.

As to their number, characters are combined, grouped and arranged, and from the aggregate of the simple result general characters, which serve to unite under one common denomination a certain number of vegetables.

Several characters have a mutual dependance on each other, and seem to be inseparable. Those which are taken from the flower and the fruit are chiefly of this kind. It is thus, for instance, that an inferior ovary always implies a monosepalous calyx, and an epigynous insertion. The monopetalous corolla indicates almost invariably that

the stamina are inserted on it, and that they are definite in number.

According to the value and importance which the different characters possess, it is easy to foresee that the more fixed and constant must have been employed for the fundamental divisions of the vegetable kingdom. Thus the embryo has served as a basis for the three first great divisions of vegetables. The stamina and the floral integuments have been afterwards employed to subdivide the three first sections, established on characters derived from the embryo.

Let us now try to explain the means by which vegetables have been united in natural groups or families. And let us begin by first giving an idea of the words, species, variety, genus, order and family.

The plants scattered over the surface of the globe form the individuals of the vegetable kingdom. When examined attentively, we cannot fail to perceive that a great many of them always appear to us under the same aspects, with the same internal and external characters, and that they are always reproduced under the same form. It is to this assemblage of beings, perfectly similar to each other, considered in the abstract, that we give the name of species. A species is, therefore, a collection of individuals which constantly reproduce each other of the same form. The seed

of any given species will always produce an individual which shall be perfectly similar to itself. The characters upon which the distinction of the different species is founded, are, in general, taken from the organs of vegetation, that is, from the leaves, the stem, and the roots. Species which exhibit some differences in respect to the colour of their flowers, of the place which they inhabit, or of their more or less considerable stature, constitute varieties, which are distinguished from species in this respect, that in a state of nature they are not reproduced from seeds with all their characters. Thus, for example, the lilach has usually a flower of a delicate violet colour; but sometimes the flower is white, without a corresponding change in any of the other characters. The white lilach is, therefore, only a variety of that with violet flowers.

In fact, if we sow the seeds of the white flowered lilach, it will produce individuals whose flowers will be indiffereutly either white or violet, which proves that varieties are not always preserved by the means of seeds.

A genus consists of a more or less considerable number of species, united by common characters taken from the organs of fructification, but all distinct from each other by specific characters, peculiar to each, and furnished by the organs of vegetation. Thus the genus anagallis has for its

characters a monopetalous, rotate, corolla, five stamina, and its fruit a pyxidium ; that is to say, a globular capsule, opening circularly by a kind of lid. All the species of this genus must have these different characters ; but they will be distinguished from each other by the forms of their stems and leaves, &c. The same may be said of the genera.

By uniting together genera in the same manner as species, that is to say, by collecting into the same group those which have common and similar characters, we form orders, properly so called, if we regard only a single character, such as the number of stigmas or the form of the fruit, &c. and natural orders or families, when for the formation of such an assemblage there is required the concurrence of all the characters that may be derived from the form, structure, and relative situations of all the organs of the vegetables which are classified.

By a natural order or family of plants, we must, therefore, understand a series or assemblage of genera, more or less numerous, which have all the same characters in the organs of fructification.

Thus the family of the cruciferæ has for its characters a dicotolydonous embryo, a fruit which is a siliqua or a silicula, usually four petals opposite two and two, stamina of a definite number,

&c. All the genera of this family must have the same characters, but with some slight modifications, which will not alter their primitive type, and which will serve to establish the differences of the genera whose union constitutes this family.

It is by following a similar course that other vegetables have been collected into natural groups or families. But as these families are rather numerous, it has been found necessary to distribute them into more or less numerous classes, trying to preserve among them the same analogy and the same affinity. This classification of families has received the name of Jussieu's method, or the method of natural families.

We shall now see what are the characters that this celebrated author has employed for the formation of these different classes.

This method has been divided into fifteen classes. The first divisions are founded on the characters which may be taken from the presence or absence of the embryo: hence the embryonate and inembryonate vegetables.

Embryonate plants are distinguished according to the number of their cotyledons, 1stly, into monocotyledons, and 2dly, into dicotyledons. All vegetables are reduced to these three great primordial divisions:

The acotyledonous.

The monocotyledonous.

The dicotyledonous.

The second consideration, that which truly serves for the establishment of classes properly so called, is founded on the relative insertion of the stamina, or of the monopetalous staminiferous corolla. Now we have seen that there are three kinds of insertion.

1st. The hypogynous insertion, or that in which, the ovary being entirely free, the stamina or staminiferous corolla are inserted around its base.

2nd. The perigynous insertion, or that wherein, the ovary being free or parietal, the stamina or monopetalous staminiferous corolla are inserted on the calyx, or at a certain distance from the circumference of the base of the ovary.

3d. The epigynous insertion, or that wherein the ovary is always inferior, or where the stamina or staminiferous corolla are inserted on the upper part of the ovary.

These three kinds of insertion serve to establish the same number of classes, namely:

The acotyledonous plants being destitute of embryos, and, therefore, of flowers and fruit, could not enter into this classification. They constitute the first class.

The monocotyledonous exhibiting these three modes of insertion, have been divided into three classes; 1st, the monocotyledonous with hypogynous stamens; 2d, the monocotyledonous with

perigynous stamens; 3d, the monocotyledonous with epigynous stamens.

The acotyledons and monocotyledons form, therefore, four classes.

Acotyledons	....	1st
Monocotyledonous	hypogynous stamens	2d
	perigynous stamens	3d
	epigynous stamens	4th

The dicotyledonous plants being much more numerous than the acotyledonous and monocotyledonous together, it was found necessary to multiply the number of their divisions. In them, the consideration of the insertion was still adhered to, but it became only a secondary character. Thus, it was remarked, that they are either destitute of a corolla or apetalous, or that they have a monopetalous staminiferous corolla, or that their corolla is polypetalous. This distinction has served as a basis for three divisions, which were first established in dicotyledonous plants, namely:

1 Dicotyledonous apetalous.
2 ———————— monopetalous.
3 ———————— polypetalous.

The insertion was next employed as a secondary character, for the purpose of dividing these three sections into classes.

Thus the apetalous plants form three classes, in which the insertion is epigynous, perigynous, and hypogynous.

Monopetalous plants, whose corolla always bears the stamina, also form three classes, accordingly as their staminiferous corolla is hypogynous, perigynous, or epigynous. This third class of monopetalous plants has been again subdivided accordingly as the stamina are free or united by their anthers, which increases the number of classes of monopetalous plants to four.

Monopet.	stamina hypogynous		1
	stamina perigynous		2
	stamina epigynous	anthers united	3
		anthers free ...	4

These four classes, together with the three classes of the dicotyledonous apetalous plants, and with the four of the monocotyledonous and acotyledonous plants, in all form eleven classes.

The polypetalous plants have been also divided into three classes, according to their mode of insertion, which is epigynous, perigynous, or hypogynous.

Lastly, in the fifteenth and last class are placed all the dicotyledonous plants, whose flowers are essentially unisexual and separated on distinct individuals.

They have received the name of irregular diclinous plants. Such are the fifteen classes which Jussieu has established in the vegetable kingdom,

in order to arrange methodically the different families of plants which he had before created.

Each of these classes, in fact, contains a more or less considerable number of natural families, all united by the common character which constitutes the class. The number of these classes is not definitively settled, nor, in fact, can it be so. New discoveries, more accurate and correct observations, by making known new objects, or by demonstrating the difference existing between vegetables before united and confounded, will continually increase the number of the families of plants. When in 1789 M. de Jussieu* published his Genera Plantarum, he described 100 families. In the course of this work we shall give the characters of more than 160, and even this number is susceptible of augmentation. M. De Candolle has also published a series of families arranged in

* It was made a subject of accusation against Jussieu, that he had not given a proper name to each of his fifteen classes as Linnæus had done in his artificial system. That celebrated botanist was too well aware of the justice of the charge, not to have applied a remedy. He has, therefore, given a particular name to each of those classes. It was from a note which he had the goodness to transmit to us, that we have taken the names which will be found at the head of each class in the following list. The only alteration that we have taken the liberty of making, is, that of giving them a substantive termination. Thus, we have said monohypogyny instead of monohypogyneæ; peristaminy instead of peristamineæ, &c. &c.

a peculiar order, almost the inverse of that which was adopted by M. De Jussieu. Without at all meaning to decide upon the superiority of the one or the other of these classifications, we shall explain that of M. De Jussieu, as being the most generally adopted, and as being, moreover, conformable to the classes which we have already adverted to.

A KEY TO THE METHOD OF NATURAL FAMILIES,

OF M. A. L. DE JUSSIEU.

				Classes.
ACOTYLEDONOUS VEGETABLES		.. .. ..		1. Acotyledony.
MONOCOTYLEDONOUS ..		Stamina hypogynous		2. Monohypogyny.
		——— perigynous		3. Monoperigny.
		——— epigynous		4. Monoepigyny.
DICOTYLEDONOUS.	Apetalous. Apetaly.	Stamina epigynous		5. Epistaminy.
		——— perigynous		6. Peristaminy.
		——— hypogynous		7. Hypostaminy.
	Monopetalous. Monopetaly.	Corolla hypogynous		8. Hypocorolly.
		——— perignous		9. Pericolly.
		——— epigynous *Epicorolly.*	anthers united.	10. Synanthery.
			——— distinct.	11. Corisanthery.
	Polypetalous. Polypetaly.	Stamina epigynous		12. Epipetaly.
		——— hypogynous		13. Hypopetaly.
		——— perigynous		14. Peripetaly.
		Irregular Diclinous		15. Dicliny.

A TABLE

OF THE

FAMILIES OF THE VEGETABLE KINGDOM,

ARRANGED ACCORDING TO THE METHOD OF

ANTOINE LAURENT DE JUSSIEU.

FIRST DIVISION.

INEMBRYONATE PLANTS.

This first division of the vegetable kingdom corresponds with the cryptogamia of Linnæus. It contains all the vegetables, which, being destitute of true organs of generation, that is to say, of stamens and pistils, have received the name of agamous plants, and are reproduced by means of corpuscles, similar in their structure and developement to the bulbils which are observed on certain phanerogamic vegetables. Linnæus called these plants cryptogamic, because he believed that their fecundation was effected by the means of organs as yet but little known. M. De Candolle remarking that only one anatomical element enters

into their composition, namely, cellular tissue, calls them cellular vegetables, in opposition to the name of vascular vegetables, which he gives to phanerogamic plants. Thus we comprise under the name of agamic plants all the acotyledonous plants of M. De Jussieu, that is to say, all those which have been arranged by Linnæus in cryptogamia, or in the last class of his system.

Several authors have divided them into two classes, namely, into the cryptogamic and the agamic properly so called. Among the former they rank the salvineæ, equisetaceæ, musci, hepaticæ, lycopodiaceæ, and ferns, which they consider as possessed of sexual organs, but very small, and scarcely distinguishable. In the second class are found the truly agamic plants according to them, such as the algæ, lichens, and fungi, in which nothing can be discerned that can be compared to stamina and pistils. But we do not admit this distinction. The organization of these vegetables differs too much from that of the phanerogamic to admit the opinion that they are possessed of the same organs. We therefore think with Necker, that the plants designated by the name of cryptogamic are entirely destitute of sexual organs; that nothing in them can justly be compared with the same parts in phanerogamic vegetables.

More than once, in the course of this work, we have shewn the extreme difference which

exists between all the parts of these vegetables and those of phanerogamic plants. We have proved that the bodies regarded by authors as seeds are not really such, inasmuch as they contain no embryo. They, however, give birth to beings perfectly similar to those from which they are detached. But as we have often remarked before, the bulbils of certain perennial plants, and a great number of buds, produce the same effect, without our being, therefore, warranted to consider them as true seeds. Besides, how does this pretended germination of agamic plants proceed. Can it be compared to that of plants provided with an embryo? The reproductive corpuscle of a fern, of a fungus, &c. being placed in the earth will grow, it is true; but as in the case of phanerogamic plants, they are not parts already formed, and reduced as it were to their rudimental state, that will successively acquire a greater developement; but, on the contrary, parts will be produced which are entirely new. It will not be a growth of organs already existing; but the substance of the sporule or reproductive corpuscle, being drawn out on one side to sink into the earth and to form a root, when the vegetable is to have one, will form on the other side a stem by being prolonged in the opposite direction. In whatever position the sporule may be placed, the point in contact with the earth will be always pro-

longed to form the root, and the opposite point will form the stem. These two organs do not, therefore, exist previous to this developement. They are created by the influence of certain circumstances which seem to be fortuitous and foreign to the nature of the body which produces them.

If we pass on to the examination of the parts considered as flowers by different authors, we shall find the greatest possible diversity in their opinions. Some, in fact, call male flowers, what others describe as female flowers. Thus, in the mosses, Linnæus regards the urn as a male flower, Hedwig as a female flower, Palisot Beauvois as an hermaphrodite flower. Whenever these vegetables present, as the mosses for example, two very distinct kinds of peculiar organs, considered as those of fructification, authors could have been embarrassed only as to the choice they should make of them, and as to the function they should attribute to each. But in the jungermanni, where there are sometimes found three or four kinds of fructifications differing from each other in their external form, as there are only two kinds of sexual organs, the male and the female, we should, in this case, be compelled to admit the existence of four. For if we give the name of sexual organs to two of these parts, why refuse it to the other two, whose internal structure is the

same, but which differ only in their external form or position?

In ferns, on the contrary, where there is evidently but one species of fructification, wholly formed of little grains, usually contained in a species of small membranous bags, and which have been considered as little seeds, where are the stamina? Where is the stigma which has received the influence of the pollen? Where are the pistillary cords by which it is transmitted to the ovula? Is it a satisfactory answer to this question, to say with Micheli and Hedwig, that the hairs observed upon the young leaves are the stamina; or with Hill and Schmidel, that the male flowers are the rings that surround the receptacles which contain the little seeds, &c?

It must be admitted that opinions so different, and even so completely opposite upon the same subject, lead to a conclusion which appears to us inevitable; which is, that the pretended flowers of agamic plants, sometimes looked upon as containing stamina, sometimes as containing pistils, are not really flowers. They are peculiar organs, species of buds, to which nature has confided the care of reproducing these singular vegetables. Wherefore, in fact, should we wish to restrict within the narrow limits of our own conceptions, the powers of nature? Her means are as various as her powers are great. And if she has given to

agamic plants an aspect so different from that of the phanerogamic ones, and external organs which have nothing that can be compared with theirs, wherefore should she not have also bestowed upon them a peculiar mode of reproduction, in which there is nothing analogous to that of phanerogamic vegetables, but the effect it produces, that is, the formation of organs which are to perpetuate the species?

FIRST CLASS.

ACOTYLEDONY.

FIRST FAMILY.

HYDROPHYTA.—*Algæ* auct.—*Algarum pars.* JUSS.

THE first beginnings of vegetable organization, the plants which compose this family are the simplest which are known to us. Some of them appear at their origin under the form of small globules or vesicles either grouped or isolated, which being united by their extremities, or being variously aggregated, form filaments or tubes either simple or branched, continuous or jointed, thin plates of various figures, or a species of net work. The hydrophyta in fact are all those plants which vegetate in fresh or salt water and inundated places. Their texture appears in general to be

homogeneous, composed of cells of various forms, and according to Lamouroux and Bory de St. Vincent, of some vessels constituting longitudinal fibres. Their organs of fructification are dehiscent or indehiscent sporangia, containing very small sporules. These organs are variously grouped and placed within the vegetable texture, seldom without it, under the form of tubercles. The organs of the tubular hydrophyta are sometimes united in globules, sometimes arranged in spirals. Hydrophyta exhibit all the shades of green or of purple.

This family contains the plants generally known by the name of algæ or marine plants. They are divided into two great tribes, which several authors have again subdivided accordingly as they grow in fresh water, or as they inhabit salt water. These tribes are the confervæ and the thalassiophytæ. These plants have been the object of the labours of many modern naturalists, among whom we shall mention Messrs. Turner, Lyngbie, Lamouroux, Bonnemaison, Mertens, Agardh, and particularly Bory de Saint Vincent. To the works of these writers we must refer those who are anxious to obtain a more detailed account of the structure and classification of these vegetables.

The family of the hydrophyta forms the link of connexion or the transition from the animal to the vegetable kingdom. In fact the oscillatoria and conjugata are as it were mixed beings, which have been in turns referred to animals and to vegetables. The former, from the spontaneous and various motions which they execute, the latter from their mode of fecundation and growth seem to have all the characters of animality, while from their structure and form, they cannot be removed from the confer-

væ, which are destitute of all species of motion, and belong unquestionably to the vegetable kingdom. It is therefore impossible to find a distinct line of demarcation between the animal and vegetable kingdoms. It has been said that certain algæ were by turns and in succession animals and vegetables, that is, that there was a real transmutation from one kingdom into the other. But the recent observations of the most accurate naturalists prove, that such a transformation does not exist.

Translator's Note.—Fucus helminthocorton, or the Corsican moss, is used on the Continent as a vermifuge. As such, it enjoys a considerable reputation, and is given to children in doses varying from one to six drachms. It is scarcely ever obtained pure, being always adulterated with some other species of the same genus, and even with species belonging to some other genera.

The ashes of several species of algæ have been recommended as a specific in swellings of the thyroid gland. Their efficacy is now ascertained to depend on iodine, which they contain in the state of hydriodate of potash or of soda. F. Vesiculosus, saccharinus, &c. are particularly mentioned as abounding with this principle.

SECOND FAMILY.

Fungi. Jussieu.

Vegetables extremely variable in their form, consistence, colour, &c. They are fleshy or corky bodies, having sometimes a form which may be compared with that of a parasol, that is to say, composed of a cap (pileus) which is usually convex, and bearing on its under surface perpendi-

cular plates, tubes, or anastomozing lines. 2d. Of a central or lateral peduncle (stipes,) at the top of which is seen a circular membrane (annulus) which extends to the circumference of the cap. The entire fungus is sometimes covered before its developement by a kind of membranous bag, complete or incomplete, which is called volva. At other times the fungi are globular masses, either ovate or oblong sections, a species of filaments either simple or jointed, truncs of a coralline form, that is, irregularly branched like a coral, and whose colours are extremely variable, sometimes exhibiting the most vivid tints, but whose internal structure, composed of irregular cells, is never green. The sporules or reproductive organs are sometimes naked, sometimes contained in a kind of small capsules (thecæ.) They are either spread over the surface of the fungus, or contained in a peridium or fleshy seed-vessel, either membranous or hard and woody.

The fungi are in general parasitical plants, which grow either upon other vegetables still living, or upon organized bodies in the state of putrefactive decomposition, either on the surface of the earth, or sometimes under it. Their growth sometimes proceeds with extraordinary rapidity, and their duration is sometimes very fugitive; while others (boletus igniarius, ungulatus, &c.) vegetate slowly, and during many successive years. A very small number of species grow in water.

Fungi form several natural groups, which some authors consider as distinct families. These are:

1st. The fungi, properly so called. Vegetables either fleshy,

corky, or woody, having their sporules placed in capsules, whose union constitutes a membrane (hymenium) variously folded, and covering either wholly or partially the surface of the fungus. Ex. Agaricus, Boletus, merulius, morchella, clavaria, &c.

2nd. Lycoperdaceæ are formed of a fleshy or membranous peridium, at first closed, but opening afterwards, and containing naked sporules without capsules, and escaping from the peridium or receptacle in the form of dust. Ex. lycoperdum, geastrum, stemonitis, desmodium, &c.

3rd. The Hypoxyleæ, which present themselves under the appearance of tubercles or conceptacles of very various forms, opening by a cleft or a pore, and containing small capsules (thecæ) full of sporules in a kind of glutinous pulp. Ex. Hysterium, sphæria, Erysiphe, &c. It is necessary to separate from this group the hypoxyleæ lichenoideæ of De Candolle, which, with the exception of the genus hysterium, belong to the lichens.

4th. Mucedineæ. These are filaments either branched or interwoven, bearing sporules without capsules. For example, all the species of mucor and the numerous genera which are formed of it.

5th. The uredineæ. The sporules are contained in capsules, either free or placed without order upon the surface of a filamentous or powdery base. Ex. Uredo, &c.

The family of the fungi is distinguished from the Algæ and Lichens by the absence of every kind of frond or of crust, bearing the organs of fructification.

Translator's Note.—Some fungi are eatable, others are poisonous.

We ought to reject as poisonous, those which have a disagreeable smell and taste, or whose flesh is soft and watery; those which grow in shady and moist situations, and which are easily spoiled; those whose taste is bitter, astringent, and too pungent; those which change their colour, when first cut.

A bright red colour is often an indication of deleterious properties.

THIRD FAMILY.

LICHENS. *Licheneæ.* HOFFM.—*Algarum.* JUSS. *et Hypoxylorum, pars.* D. C.

FRONDS or Thalli extended in the form of membranes or of membranous crusts, of varied consistence, simple or variously lobed, or of simple or branched stems, or lastly of a species of powder. The sporules are contained in seed vessels, which are generally called apothecia. The latter vary singularly in their forms, which is orbicular, oblong, linear, convex, concave, &c.; in their colour, which is often brilliant; in their position on the thallus; they are, moreover, sessile or stipitate, with or without a marginal edge, &c.

It is upon these different modifications that the numerous genera of this family have been established, which are all branches of the old genus lichen of Linnæus.

Lichens are in general parasitical plants, living upon the bark of other trees, or sometimes upon the humid earth, or upon the most barren rocks. Their substance is in general rather dry, and as it were horny. It is reduced, in some species, by boiling to a jelly, which is employed as food. The genera of this family are excessively numerous, and each of the authors who have studied it has proposed a new classification. We shall quote as examples of this family the genera, parmelia, sticta, usnea, opegrapha, stereocaulon, &c.

Translator's Note.—Rocella tinctoria yields litmus, and lecanora tartarea forms cudbear. They are both used for dying purple. Cenomyce rangiferina is the food of the rein deer, and is, therefore, the source from which the Laplander derives his principal means of support.

Cetraria Islandica is the only species which is now used in the practice of medicine. In Iceland it is employed as an article of food, being first ground to powder, and then boiled to a paste with milk. Its efficacy in phthisis and other diseases of the lungs, if it have any, must depend upon its nutritious quality, and not upon any peculiar power of controlling that destructive disease in its progress.

Other lichens have been formerly used for a similar purpose, and probably might again be employed with advantage in cases of necessity, such as lobaria pulmonaria, peltigera aphthosa, and bæomyces pyxidatus. These are more acrid and astringent than cetraria Islandica, and therefore less valuable; but those qualities may be removed by repeated washings.

FOURTH FAMILY.

Hepaticæ. Jussieu.

These are plants intermediate between the lichens and mosses, sometimes extended into simple or lobed membranes and traversed by a midrib which has been considered as a stem, sometimes having an arborescent form, that is to say, composed of a small branched stem, bearing sessile leaves. The generative organs are very various, sometimes placed on the surface of the frond, sometimes axillary. They are either globules filled with a viscid fluid, and united in a kind of capsule or perianth, or sometimes sporules, whose

form varies, and which connected by filaments rolled spirally, are contained in a capsule, which opens either by a slit or by four valves, and which is accompanied by a membrane, that often covers it wholly before its developement. This capsule is sessile or borne upon a long filament or foot-stalk.

The reproductive organs are so various in this family, that in blasia pusilla they are observed to have five different forms. It was, therefore, a mistake of several authors to suppose that they found male and female flowers in the hepaticæ. They have given the name of stamina to globules filled with a kind of viscid fluid, and of pistils to capsules filled with sporules. But how are we to name the five different organs observed in blasia? As examples of this family we shall mention marchantia, riccia, blasia, jungermannia, &c.

Translator's Note.—These plants are not used in medicine. Marchantia polymorpha was regarded by the ancients as a specific in diseases of the liver, and hence the origin of its name hepatica.

FIFTH FAMILY.

Musci. Juss.

Mosses are small plants which love to inhabit humid and shady places. They grow on the earth, on trunks of trees, or upon walls and old houses. In port, they resemble small phanerogamic plants in miniature. Their roots are very fine and tuft-

ed, their stem simple or branched, their leaves small, of various forms, but usually narrow and awl-shaped. Their sporules are contained in a kind of capsules called urns (thecæ) borne upon a slender bristle (seta) of greater or less length, enveloped at first in a kind of bag, which bursts circularly at its middle, and whose lower part, which remains at the base of the seta, is called vaginula, while the upper part which covers the top of the urn has received the name of calyptra. The urn itself presents within it a central axis called columella, and opens by means of a circular lid (operculum.) The edge of this opening of the urn is called peristomium, and is distinguished into the inner and the outer. It may be furnished with teeth, with lashes, closed by a membrane, or quite naked. Independantly of these organs there are seen some of another description. These are irregularly ovate and oblong bodies, borne upon a very short footstalk, and accompanied with jointed filaments.

The authors who have admitted in mosses the existence of flowers composed of the same organs with those of phanerogamic flowers, have differed widely as to the functions of these organs, and as to the names which it was fit to bestow upon them. Thus, Hedwig, whose labours have shed so much light upon the history of the plants of this family, considers the mosses as provided with male and female flowers. The ovate and vesicular corpuscles, intermixed with jointed filaments, are to him male flowers, each of which is a grain of pollen, naked and supported on a foot stalk. The urns, on the other hand, con-

stitute female flowers. With Palisot de Beauvois, the urn is an hermaphrodite flower, whose central columella is the pistil, and the granules which surround it, the pollen. With the same author, the male flowers of Hedwig are but simple buds or bulbilli of a peculiar nature. Dillenius, on the contrary, describes the urn as a male flower. Hill sees in it an hermaphrodite flower, whose little seeds are the ovula, and the teeth of the peristomium, the stamina, &c.

But each of these theories, and a crowd of others which it is not my object here to mention, are opposed to each other mutually, and mutually destroy each other. A great many objections may be raised against each of them. As to the opinion of Hedwig, if the urn be but a fruit, proceeding from a fecundated ovary, why does the fruit often come to maturity, when the pretended stamina by which it is to be fecundated, have scarcely begun to make their appearance? How is fecundation effected in the species, where male flowers have not as yet been discovered, &c.?

If the urn be an hermaphrodite flower, the columella the pistil, and the little seeds be grains of pollen, why, in some genera, is the columella entirely solid, and formed of a hard and perfectly homogeneous substance?

If, as Hill thinks, the teeth of the peristomium are its stamina, where are those stamina in the genera whose peristomium is naked, &c. Ex. sphagnum, mnium, hypnum, buxbaumia, tortula, &c.

The organization of mosses is so peculiar, that it is impossible to confound them with the other families of inembryonated plants.

TRANSLATOR'S NOTE.—Polytrichum commune was forformerly employed as an expectorant and sudorific.

SIXTH FAMILY.

Lycopodiaceæ.—Richard.

In port, the lycopodiaceæ occupy the place between the mosses and ferns. They are provided with a branched stem, often spreading and creeping, and with very numerous and very small leaves. The organs of fructification present two modifications. Sometimes they are very small, globular capsules, triangular or reniform, one-celled, containing a great number of very small sporules; sometimes the capsules are a little larger, opening by two or three valves, and containing only three or four sporules of a larger size. These two kinds of capsules, which are sometimes found united on the same individual, are either axillary and solitary, or united in the axilla of bracteas and forming simple or digitate spikes.

The genus lycopodium, which forms the type of this family, had been placed by Linnæus among the mosses, and by Jussieu among the ferns. But the organization and position of the reproductive organs, easily distinguish the lycopodiaceæ from the other two families. A great number of authors consider the smaller capsules, filled with very numerous granules, as male flowers, and the larger ones as female flowers. But to us they both appear to be nothing more than receptacles perfectly analogous to those we have already observed in the other families of inembryonated vegetables. The genera

which compose this family are the following: lycopodium, psilotum, tmesipteris. Professor De Candolle adds to it the genus isoetes, which, in our opinion, should remain with the marsileaceæ.

Translator's Note.—The capsules of the lycopodiaceæ contain a fine, yellow, light powder, without either taste or smell. It is very inflammable, and from this circumstance and its colour, it has received the name of vegetable sulphur. Externally, it has been applied as an absorbent to excoriations on the bodies of new-born children.

SEVENTH FAMILY.

Filices.—Jussieu.

Herbaceous perennial plants, becoming sometimes arborescent in tropical regions, in which case they grow after the manner of palms. Their leaves or fronds are sometimes simple, sometimes more or less deeply divided, pinnatifid, or decompounded. These fronds have a common character, that of being rolled inwards at their point when they are beginning to grow. Their organs of fructification are usually placed on the under surface of the leaves, along the nerves, or at their extremities. The sporules are naked or contained in a kind of small capsules. These capsules when grouped, form small masses which are called sori. The latter have the form of orbicular scales, reniform, sessile or stipitate, surrounded sometimes with an elastic ring, opening either at

their circumference, or by a longitudinal slit, or bursting irregularly. In the genus pteris the sporules are placed under the inflexed edge of the leaves, which forms an uninterrupted line. In the species of adianthum they constitute small, prominent, isolated plates, by means of the involute edge of the leaves. In certain genera they are isolated, in others they are grouped, and form longer or shorter lines. The sori begin to grow under the epidermis, which they raise up so as to be covered by it. The portion of epidermis, which thus serves as a covering to the sori, is called indlusium. In some ferns, such as the osmundæ, the ophioglossa, &c. the fructifications are disposed in racemes or spikes.

The genera of ferns actually known are very numerous; they form five natural sections, namely:

1st. Polypodiaceæ. Capsules free, bursting irregularly, surrounded with an elastic, narrow, prominent ring, which terminates in a longer or shorter foot stalk. Ex. Polypodium, Aspidium, Asplenium, pteris, &c.

2d. Gleichenieæ. Capsules free, sessile, disposed regularly in a small number of groups, surrounded in the middle by an elastic, broad, flat, ring, opening by a transverse slit. Ex. Ceratopteris, Gleichenia, Mertensia, &c.

3d. The Osmundaceæ. Capsules free, opening by a longitudinal slit into two valves; elastic ring none, or replaced by a striated cap. Ex. Anemia, Lygodium, Osmunda, &c.

4th. Marattieæ. Capsules sessile, united and cohering, representing a many-celled capsule, no elastic ring. Ex. Danæa and Marattia.

5th Ophioglosseæ. Capsules free, partly immersed in the frond, without an elastic ring, opening by a transverse slit. Ex. Ophioglossum, Botrychium.

Authors have differed much with regard to the nature of the reproductive organs in ferns. Almost all have considered the capsules as female organs. But some, as Micheli and Hedwig, have regarded as male organs the glandular hairs which appear sometimes upon the young leaves; others, with Hill and Schmidel, have given the name of stamina to the rings of the seed vessels, and some have given that name to the miliary glands and to the indusia. But the sedifferent opinions can be easily overturned; for all the organs which have been considered as stamina are by no means constant, and are often wanting.

Translator's Note.—Polypodium vulgare. Its root is sweetish and saccharine, and its powder has been used externally as an absorbent, and as a covering for pills.

P. Calaguala.

Its root has an oily disagreeable taste. It acts as a sudorific, and, in America, it has enjoyed some reputation as a cure for rheumatism and constitutional syphilis.

P. Filix mas.

The root of this species has a disagreeable odour, with a bitter and slightly astringent taste. It is used as a vermifuge, and has been particularly employed for the expulsion of the tape worm. The root of P. filix fæmina has the same properties, but in a slighter degree.

The leaves of a great many ferns are mucilaginous, slightly astringent and aromatic, and owing to these qualities they have been used as expectorants. Adianthum capillus veneris, which serves as a basis to the syrup of capillaire, is the species chiefly employed for this purpose.

EIGHTH FAMILY.

Marsileaceæ, Brown.—*Rhizospermeæ*, D. C.

These are small aquatic plants, fixed at the bottom of water or swimming on its surface, with or without a visible stem. The leaves are setaceous, or more or less broad. The reproductive organs are a species of coriaceous involucres, sometimes of one kind only, sometimes of two different kinds. They are thick, of one or more cells, separated by membranous partitions, either indehiscent or opening by valves. They contain reproductive corpuscles, which are sometimes all organized in the same way, and are sometimes of two different kinds; the one larger, which are considered as female, the other smaller, which are considered as stamina. These involucres are placed at the base of the leaves, and sometimes even adhere to them. When the involucres are of two kinds on the same plant, the one are membranous, and contain a cluster of corpuscles, which are considered as seeds. The others, which have been described as male organs, contain a great number of sphærical granules attached by a long filament to a central column.

This family has been divided into two sections; the true marsileaceæ, which have but one kind of involucres, containing two sorts of granules, and composed of the genera marsi-

lea, pilularia and isoëtes, the last of which some authors place among the lycopodiaceæ and the salvinieæ, whose involucres are of two different kinds, and contain granules differently organized. To this second tribe belong the genera salvinia and azolla.

NINTH FAMILY.

Exquisetaceæ.

THIS little family comprises only the single genus equisetum, known in French by the name of presle (horse tail.) All the species which compose this group are herbaceous, perennial plants. Their stems, either simple or branched, are in general hollow, presenting longitudinal striæ, and having knots at different distances, from which grow sheaths cleft into a great number of ligulate pieces, which seem to be verticillated leaves united together. Sometimes from these knots grow verticillated branches. The fructification forms terminal spikes. These spikes are composed of thick peltate scales, similar to those which are observed in the male flowers of many of the coniferæ, and among others, of the yew. On the under surface of these scales grow a species of capsules, disposed in a single row, and opening by a longitudinal slit, which looks towards the axis. These capsules are filled with very fine granules, which are composed of a globular part, from the base of which grow four long jointed filaments, swelled at the

upper part, and rolled spirally around the globular body, which is a true sporule.

Influenced by the analogy of form, which exists between the reproductive organs of the equisetaceæ and the stamina of some coniferæ, Linnæus called these organs stamina, without pointing out the organs which he regarded as pistils. Hedwig, on the contrary, considered each granule as an hermaphrodite flower; the globular part was the pistil, and the filaments were four stamina whose pollen was situated externally. But these filaments are surely analogous to those which are found in the jungermanni, as in Marchantia, Targionia, &c.

Translator's Note.—They are all more or less astringent; some of them have been used as diuretics.

TENTH FAMILY.

Characeæ. Rich.

Aquatic, submersed plants, whose stems, which are slender, green, and sometimes transparent, bear at different distances verticillated branches to the number of eight or ten. Upon the branches of the upper whorls there are found a species of sporangia or capsules, amounting to three, four, or five. Each of them is surrounded at its base by two or three bracteas or abortive branches, which Linnæus considered as calyces. They are one-celled, and contain numerous sporules united into a single mass, which has been regarded as a single seed. These sporangia are formed of two integuments, the one external,

membranous and transparent, very thin, terminating above in five small, spreading teeth, of the form of a rose. The inner is hard, dry, opake, composed of five small, narrow valves, twisted spirally. Besides these organs, there are also observed upon the branches a kind of reddish, sessile, rounded tubercles. Most authors describe them as stamina. They are composed of a transparent reticulated membrane, forming a kind of vesicle, filled with a mucilaginous fluid, in which are observed whitish jointed filaments, and others of a larger size, closed at one of their extremities, appearing to be open at the other and filled with a reddish fluid. These tubercles, in the progress of vegetation, shrink, but never open.

This family is composed of only a single genus chara. It had been established by Vaillant in 1719, in the Memoirs of the Academy of Science of Paris. Linnæus had first placed it among the cryptogamic plants, next to the lichens. Afterwards he changed his opinion, and ranked it among the phanerogamic plants in monœcia monandria.

Jussieu in his genera placed it among the Naiades, but Professor Richard made it the type of a distinct natural family, under the name of Characeæ, and placed it among the acotyledonous plants. More recently Robert Brown has ranked this genus with the hydrocharideæ, M. Leman with the onagrarieæ, and lastly Martius, Wolrath, and Bory de Saint Vincent, think it has great resemblance to the hydrophyta, and that it should be placed in that family. But if we compare the structure of the reproductive organs of the characeæ with that of the other acotyledonous plants, we shall find in them a very striking resemblance, par-

ticularly to the marsileaceæ, from which they differ only by their smaller sporangia, with five teeth and a double integument, and by the reddish tubercles which are also observed upon their branches,

SECOND DIVISION.

EMBRYONATED, OR PHANEROGAMIC PLANTS.

This second great branch of the vegetable kingdom is composed of all the plants whose structure is more complicated, which are provided with sexual organs, male and female, that is to say, with stamina and pistils, and which are reproduced by the means of true seeds, requiring to be fecundated, in order to be fit to give birth to new individuals. According to the structure of the embryo, they have been divided into two groups, the monocotyledonous and the dicotyledonous.

OF THE MONOCOTYLEDONOUS PLANTS.

In the structure of the embryo resides the essential character of the vegetables which form this group. This embryo is monocotyledonous. But besides the characters taken from the embryo, there are others derived from the organs of vegetation and of fructification, and which, in the absence of the former, may serve to distinguish a monocotyledonous vegetable. We shall briefly mention them.

1st. The internal structure of the stem composed of a mass of cellular tissue, in which are scattered vasicular bundles, (see page 97, the organization of the monocotyledons, page 122, their mode of developement.)

2d. The nerves of the leaves are, in general, parallel in the monocotyledons, while they are irregularly branched in the dicotyledons.

3d. The perianth is always simple in the monocotyledons, that is to say, there is only a calyx, which is sometimes coloured like petals.

4th. In general, in monocotyledonous vegetables, the floral organs are three, or a multiple of three, while the number five prevails in the dicotyledons.

But it is particularly the port, the general aspect, that differs in these two great branches of the vegetable kingdom; and when once the characters of the principal families of the monocotyledonous plants are well understood, such as the grasses, the junci, the liliaceæ, the irideæ, the amomeæ, the orchideæ, the palms, &c. it is afterwards easy to distinguish, simply by their port, the monocotyledonous from the dicotyledonous vegetables.

The monocotyledonous plants are divided into three classes, accordingly as their insertion is hypogonous, perigynous, or epigynous.

SECOND CLASS.

MONOHYPOGYNY.

ELEVENTH FAMILY.

Nayadeæ. Juss.—*Fluviales. Vent: Potamophileæ.* Rich.

The nayadeæ, as their mythological name denotes, are plants which either grow in the water, or swim on its surface. Their leaves are alternate, often amplexicaul at their base; their flowers very small, are unisexual, monœcious, or more rarely diœcious. The male flowers consist of a stamen, either naked or accompanied with a scale, or lastly enclosed in a spatha which contains two or a greater number of flowers. The female flowers consist of a pistil, either naked or contained in a spatha. They are sometimes solitary, sometimes twin, or lastly united in greater numbers, and sometimes surrounded by male flowers in a common integument, so as that their union seems to form an hermaphrodite flower. The ovary is free, one celled, containing a single pendant ovule, (in the genus nayas it is lateral and almost basilar.) The style is generally short, terminated by a stigma, sometimes simple, discoid, flat, and membranous (Zannichellia ;) sometimes having two or three long and linear divi-

sions. The fruit is dry, one-seeded, indehiscent. The seed contains under its proper integument an embryo, generally curved backwards on itself, having its radicle very large and opposite to the hilum.

Ex. Nayas, Zostera, Ruppia, Zannichellia, and Potamogeton.

The genera which we have now enumerated are the only ones which compose the family of the nayades, whose characters we have greatly modified, having given an explanation of its structure different from that of any previous writer. Many genera must be excluded, which were improperly referred to it, such as hippuris and myriophyllum, which form the family of the holorhageæ, ceratophyllum, which has been added to the salicarieæ, saururus and aponogeton, forming the family of the saurureæ, callitriche, a dicotyledonous genus, allied to the euphorbiaceæ, chara, an acotyledonous genus, forming the family of the characeæ.

The family of the nayades is nearly related to the aroideæ, which it resembles in its port and its characters. The aroideæ differ from it chiefly by their erect ovule, and their embryo contained in a fleshy albumen.

TWELFTH FAMILY.

Aroideæ. Juss.

Perennial plants with usually a tuberose root; with leaves often radical or alternate upon the stem; flowers disposed on a spadix, which is usually enclosed in a spatha of various forms; unisexual, monœcious, destitute of floral integuments, or hermaphrodite, and surrounded by a calyx of

four, five, or six divisions. In the first case, the pistils occupy in general the lower part of the spadix, and ought to be considered, each as a female flower, and the stamina as so many male flowers; rarely the stamina and pistils are mixed together. In the second case the flowers, instead of being considered hermaphrodite, may be described as a combination of unisexual flowers. Thus each of the stamina with its scale constitutes a male flower, and the central pistil a female flower. The ovary is in general one-celled, containing several seeds attached to the bottom, or three-celled; the stigma is sometimes sessile, more rarely borne upon a very short style. The fruit is a berry, or more rarely a capsule, which is sometimes one-seeded by abortion. The seeds, besides their proper integument, consist of a fleshy albumen, in which is placed an erect, cylindrical embryo.

The family of the aroideæ is divided into three tribes, to wit:

1st. Tribe, the true aroideæ; flowers naked without scales, fruit fleshy.

Arum, arisarum, caladium, calcasia, calla, richardia.

2d. Tribe, the orontiaceæ. Flowers surrounded with scales in the form of a calyx: dracontium, pothos, carludovica, orontium, acorus.

3d. Tribe, the pistiaceæ. Fruit dry and capsular. Pistia, ambrosinia.

Allied to the nayades and typhaceæ, this family is particularly distinguished by its port, the disposition of its

flowers, its embroyo contained in an albumen and many other characters.

Translator's Note.—Their roots abound with fecula, which may be used as an article of food, when deprived of its acrimony either by roasting or repeated washings. Arum esculentum, and colocasia, have been used for this purpose.

Acorus calamus contains essential oil, resin, extractive principle, gum, and inuline. It is accounted one of the most agreeable of all the aromatics which are natives of Europe.

THIRTEENTH FAMILY.

Typhineæ. *Typhæ.*—Juss. *Pandaneæ.*—Rob. Brown.

Plants either aquatic, or terrestrial and arborescent, with alternate sheathing leaves at their base, and unisexual monœcious flowers. The male flowers form cylindrical or globular catkins, composed of numerous stamina, often united many together by their filaments, and intermixed with hairs or small scales; but without order and without a proper calyx. The female flowers disposed in the same manner, have sometimes their scales united to the number of six around the pistil, and forming a calyx of six sepals. This pistil is sessile or stipitate with one, more rarely with two cells, containing each a pendant ovule. The style, scarcely distinct from the top of the ovary, terminates in a broad, as it were membranous

stigma, and marked with a longitudinal groove. The seeds consist of a farinaceous albumen, containing in its centre a cylindrical embryo, whose radicle is superior, that is to say, has the same direction with the seed.

This little family consists only of two genera, typha and sparganium. M. R. Brown has united it with the family of the aroideæ, with which it has, in fact, many points of agreement; but yet it differs from them in many characters, and among others by its reversed seeds and the structure of its flowers. Yet these two families ought perhaps to be united. Ought we place in this family the genus pandanus, which has so strong a resemblance to the genus sparganium, that it appears to be as it were an arborescent species of it? Or is it necessary, with Robert Brown, to make a distinct family of it, under the name of pandaneæ?

FOURTEENTH FAMILY.

Saurureæ.—Rich.

Plants which grow upon the water's edge, or swim upon its surface. Their leaves are alternate, simple, petioled. Their flowers are hermaphrodite, destitute of a perianth, and having a simple scale which occupies its place and upon which are inserted the stamina and pistils. The number of the former is from six to nine, having their filaments awl-shaped and their anthers two-celled, the cells opening by a longitudinal groove. The pistils are three or four in number in the

centre of each flower. They are one-celled, containing two or three erect or ascending ovules. The style is marked with a glandular groove on the middle of its inner side, which at the summit expands into a stigma. The fruit is composed of small indehiscent capsules, containing each one or two seeds. The latter under their proper integument contain a large albumen, to the top of which is applied a very small discoid embryo.

This family is composed of the genera saururus and aponogeton. As to ouvirandra or hydrogeton, which has been classed with them, it differs from them by the presence of a calyx, and by its embryo without albumen. The latter character, if it be real, which we have not had an opportunity of verifying, would remove this genus from the saurureæ to be placed among the alismaceæ.

FIFTEENTH FAMILY.

Cabombeæ.—Rich.

A small family, composed only of two genera, cabomba and hydropeltis, which contain herbaceous, perennial plants, growing in the fresh waters of the new continent. Their leaves, which swim on the surface of the water, are entire and peltate, or divided into lobes of various sizes. The flowers are solitary on long foot stalks. The calyx is of six deep divisions, or of six sepals, disposed in two rows. The stamina vary from

six to thirty-six. The number of pistils united in the centre of the flower is from two or three to eighteen, that is to say, in general one-half less than that of the stamina. Each pistil, which is of a variable length, has one cell containing two parietal or pendant ovules. The style is either long or short, and terminated by a simple stigma. The fruit is indehiscent, of one or two seeds; the latter contain under their proper integument a very large fleshy or farinaceous albumen, hollowed at its base into a little cavity in which lies a nearly discoid embryo, of the form of a nail and perfectly undivided.

This little family has much affinity to the saurureæ, by its ovary, its fruit, and its embryo. But in this latter family the flowers are naked. In the organization of its flowers it also greatly resembles the alismaceæ, from which it differs by its large albumen and the form of its embryo. M. de Candolle places the cabombeæ among the dicotyledons, and makes them a tribe of the podophylleæ; but this view appears to us to be erroneous, the embryo of the cabombeæ being certainly monocotyledonous.

SIXTEEENTH FAMILY.

Cyperaceæ.—Juss.

Herbaceous vegetables growing generally in humid places and upon the water's edge. Their stem is either a cylindrical or triangular culm, with or without knots. The leaves are sheathing

and the sheath is entire not cleft, very often furnished at its orifice with a little membranous border called ligula. The flowers form small spikes or scaly spikelets, composed of a variable number of flowers. Each flower consists of a single scale, in the axilla of which are generally found three stamina, and a pistil formed of a one-celled and one-seeded ovary, surmounted by a style simple at its base, bearing in general three filiform, villous stigmas. The stamina have a capillary filament; their anther is terminated in a point at its summit, bifid only at its base. On the outside of the ovary, there are often found bristles or scales of a variable number, sometimes even a bag which completely covers it (ex. carex.) The fruit is a globular achenium, compressed or triangular. The embryo is small, placed at the base of a farinaceous albumen, which covers it by a very thin lamina.

This family is very natural, and the number of genera which compose it is very considerable. The flowers are unisexual or hermaphrodite, and the stamina vary much in number. The genera scirpus, cyperus, schænus, mariscus, papyrus, &c., belong to this family. It has much affinity to that of the grasses, but differs from it in some characters which we shall explain after the latter family. V. Gramineæ.

Translator's Note.—These plants possess but little interest in a medical point of view. The tubers of the cyperus esculentus are fleshy, they have an agreeable saccharine taste,

and are eaten in Spain, Italy, and Egypt. Carex arenaria is slightly aromatic, and its root has been recommended as a substitute for sarsaparilla in the cure of syphilis.

SEVENTEENTH FAMILY.

Gramineæ.

Herbaceous, annual, or perennial plants, seldom suffrutescent, of a very peculiar and very characteristic port. Their stem is a culm usually fistulous, presenting at different distances large knots, from which proceed alternate sheathing leaves. This sheath, which may be considered as a broad petiole, is cleft through its entire length, and presents at its union with the leaf a kind of little collar, either membranous or formed of hairs, which is called ligula. The flowers are disposed in spikes or panicles more or less branched. These flowers are either solitary or united many together, so as to form little groups which are called spikelets. At the base of the spikelets or of the solitary flowers there are two scales, one external the other internal, forming the lepicene. Sometimes the inner scale is wanting, and the lepicene is one-valved. Each flower consists of two other scales forming the glume, of stamina generally three in number, sometimes fewer, seldom more, whose filaments are capillary and anthers bifid at both extremities; of a pistil consisting of a one-celled, one-seeded ovary, marked

with a longitudinal groove on one side, surmounted by two styles which are terminated by two feathery glandular stigmas; more rarely the style is simple or two-forked at its summit. Without the ovary, on the surface opposite to the groove there is observed in a great many genera two little scales of various forms, which constitute the glumella or nectary. The fruit is a cariopse, more rarely an achenium, naked or enveloped in the valves of the glume, which is detached and falls off with it. The embryo has a discoid form, and is applied to the lower part of a farinaceous albumen.

This family is one of the most natural of the vegetable kingdom. It consists of all the vegetables known by the common name of cerealia or grasses, such as wheat, barley, oat, maize, panick, rice, millet, &c. The genera are very numerous, and they are founded on the varied forms of the scales, which are sometimes naked, sometimes bearing on their top or back an arista or awn, sometimes even many. We shall mention as examples of this family, triticum, avena, hordeum, arundo, poa, saccharum, &c.

The family of the grasses has the greatest affinity to that of the cyperaceæ in its port and in many of its characters. But the sheath of the leaves in the cyperaceæ is entire, and cleft in the grasses; in the latter there are two scales to each flower, there is only one in the cyperaceæ; in the grasses there are two stigmas, and generally three in the cyperaceæ. The embryo is more complicated in the grasses than in the cyperaceæ.

Translator's Note.—The seeds of the grasses contain a large proportion of fecula, and some of them abound with glu-

ten. The superiority of wheat depends on the presence of a large quantity of the latter principle. The culms of the greatest number contain sugar, and that of saccharum officinarum in particular abounds with it. Either directly, by consuming their seeds, or indirectly, by using the flesh of the animals that feed on them, man derives his principal means of subsistence from the natural family of the grasses. No wonder then that they should be an object of great interest to mankind. Wheat is chiefly consumed in Europe, and in the north of Africa; rice (oryza) and Indian corn (Zea mais) are used in some parts of Africa, in the Indies, and in America. Triticum hybernum, hordeum distichon, and Avena sativa, are admitted into our pharmacopeias. Besides these, Triticum repens has been used on account of the diuretic properties of its roots, and secale cornutum, a fungous excressence which grows on the seeds of the rye is supposed to have the power of exciting the contractions of the uterus, so as to facilitate delivery. Lolium temulentum is the only example known of a poisonous plant in this family.

THIRD CLASS.

MONOPERIGYNY.

EIGHTEENTH FAMILY.

PALMS. *Palmæ.*—JUSS.

A LARGE and beautiful family, as remarkable for the port of the vegetables which compose it, as for the internal structure of their different parts. The palms are in general large trees, with a simple stem, cylindrical and naked, and which is distinguished by the name of stipe; it is crowned by a cluster of very large leaves, petioled, peristent,

pinnate, or divided into a more or less considerable number of leaflets of various forms. The flowers are hermaphrodite, or oftener unisexual, dioecious or polygamous, forming catkins or a vast cluster called *regime*, and covered before its expansion by a coriaceous and sometimes a woody spatha. The perianth is of six divisions, of which three are internal, three external, so as to resemble a calyx and corolla. The stamens are six in number, seldom three. The pistil is simple or formed of the union of three distinct or united pistils. It presents one or three cells containing each a single seed. Each pistil terminates in a style surmounted by a more or less lengthened stigma. The fruit is a fleshy or fibrous drupe, containing a very hard, bony nut, of a number of cells varying from one to three. The seed, besides its proper integument, consists of a fleshy or cartilaginous albumen, presenting sometimes a central or lateral cavity; the embryo, very small and cylindrical, is placed horizontally in a small lateral depression of the albumen.

With the exception of the fan-palm (chamærops humilis) all the other palms are exotic. They inhabit particularly the intertropical regions of the old and new continent. These trees are remarkable not only for the elegance of their forms, and the prodigious stature which many attain to; but they are also of great importance from the services which they render to the inhabitants of the country in which they are indigenous. The

fruit of a great many species, as of the cocoa and date palms, and the terminal bud of the cabbage palm, serve as food to the inhabitants of Southern Africa and of India. Many species furnish an amilaceous fecula called sago; others an astringent principle analogous to dragon's blood; some of them yield a fixed oil, such as the Ælais guineensis, which furnishes the palm oil. The principal genera are, Cocos, Phœnix, Chamærops, Ælais, Areca, Sagus, &c.

NINETEENTH FAMILY.

Restiaceæ.—R. Brown.

These are all exotic plants, having the port of rushes or of some cyperaceæ, perennial or even suffrutescent. Their leaves are narrow, or sometimes wanting. Their culms are naked or covered with sheathing scales, the sheath being cleft on one side. The flowers generally unisexual, are united in spikes or capitules, and enclosed in spathas. Their calyx, which is seldom wanting, presents from two to six deep divisions. The stamina vary from one to six. When their number is half that of the sepals in the calyx, they are opposite to the inner sepals (which is the contrary of what takes place in the junci.) The pistils are free or united, one-celled, containing a pendant ovule, terminated by an awl-shaped stigma. The fruits are capsules opening longitudinally at one side, or a kind of indehiscent nuts. The seed is reversed. The albumen is farinaceous, and the embryo, which is

discoid, is applied to the extremity of the albumen opposite to the hilum.

This family, which consists of the genera Restio, Eriocaulon, Desvauxia, and of a great number of new genera, natives of New Holland, is distinguished from the Junceæ by its embryo, which is external and opposite to the hilum, by its solitary and pendant seeds, and its stamina opposite to the inner sepals, &c. It has also some affinity to the cyperaceæ, from which it differs by its cleft sheaths, and by the structure and position of its embryo.

TWENTIETH FAMILY,

Junceæ.—Delaharpe.

Herbaceous, perennial plants, seldom annual, having their stem or culm cylindrical, naked or leafy and simple. Their leaves sheathing at their base, have their sheath sometimes entire, sometimes cleft through its entire length. The flowers are hermaphrodite, terminal, disposed in panicles or cymes, enclosed before expansion in the sheath of the last leaf, which forms for them a kind of spathe. The calyx is formed of six glumaceous sepals disposed in two rows. The stamina, which are six in number, or only three, are inserted at the base of the inner sepals. When there are only three stamina, they correspond with the outer sepals. The ovary is one-celled, three-seeded, or three-celled many-seeded, more or less

triangular. The style is simple, surmounted by three stigmas. The fruit is a capsule of one cell, or of three incomplete cells, containing three or several seeds, and opening by three valves, bearing each a dissepiment on the middle of its inner surface. The seeds are ascending. Their integument is double. The albumen is hard and farinaceous, containing towards its base a small rounded embryo.

The genera which at present compose this family are juncus, luzula and abama. M. de Jussieu (genera plantarum) had united in his family of the junceæ a great number of genera differing widely from each other. These genera, better understood, are become the types of a great number of distinct families, under the names of restiaceæ, commelineæ, alismaceæ, pontederiæ, colchiceæ.

Such as it has been recently limited by M. de Laharpe (Monograph des Joncées Mem. Soc. Hist. Nat. Paris, vol. 3.) the family of the junceæ has some affinity to the cyperaceæ, from which it differs by its flowers formed of six sepals and of six stamina; and to the restiaceæ. But the latter have their capsule of three complete cells, their seeds pendant, and their embryo external and opposite to the hilum.

TWENTY-FIRST FAMILY.

Commelineæ.—R. Brown.

A small family formed of the genera commelina and tradescantia, formerly placed in the junceæ, and of some other new genera which have been added to it. The flowers have a calyx of

six deep divisions, disposed in two rows. The three outer are green and calycine, the three inner coloured and petaloid. The stamina, whose number is six, seldom fewer, are free. The ovary has three cells containing each a small number of ovules inserted at their inner angle, and is surmounted by a style and a simple stigma. The fruit is either a globular capsule, or a triangular compressed one, of three cells, opening by three valves, each of which bears a partition on the middle of its inner surface. The seeds are seldom more than two in each cell. The embryo, which is top-shaped, is opposite to the hilum, and placed in a little cavity of an hard and fleshy albumen.

The plants which compose this family are herbaceous, annual, or perennial. Their root is formed of fleshy tubercles; their leaves alternate, simple or sheathing; their flowers naked, or enclosed in a foliaceous spathe.

This family is distinguished, 1st, from the junceæ by its port, by its calyx whose three inner sepals are coloured, by the form of it embryo. 2nd, From the restiaceæ, also by its calyx, by the structure of its capsule, whose cells are many-seeded, and its seeds axillary and not pendant.

TWENTY-SECOND FAMILY.

Pontederiaceæ. Pontedereæ.—Kunth.

Plants living in the neighbourhood of water, bearing alternate, petioled leaves, sheathing at their base; flowers either solitary or disposed in

spikes or in umbels, and growing from the sheath of the leaf which is cleft. The calyx is monosepalous, tubular, of six divisions more or less deep, equal or unequal. The stamina from three to six in number, are inserted in the tube of the calyx; their filaments are equal or unequal. The ovary is free or half inferior, of three many-seeded cells. The style and the stigma are simple. The fruit is a capsule, sometimes slightly fleshy, of three cells, rarely of one cell, containing one or more seeds attached to the inner angle. This capsule opens by three valves septiferous on the middle of their inner surface. The hilum is punctiform. The albumen, which is farinaceous, contains an erect embryo, placed in its central part, and having the same direction as the seed.

This little family is composed of only two genera, Pontederia and heteranthera. It has the greatest affinity on the one hand to the commelineæ, and on the other to the liliaceæ. It differs from the former, by its embryo having the same direction with the seed, which is the contrary in the commelineæ. By its seed, whose hilum is punctiform, while it occupies an entire side of it in the latter. It differs from it also by its tubular calyx and the many-seeded cells of its capsules. As to the liliaceæ their affinities appear to us to be still closer. But the port of the Pontederiaceæ is different; they are aquatic plants with a fibrous root. Their stigma is simple. However, I am inclined to think that the Pontederiaceæ might be united with the lilies.

TWENTY-THIRD FAMILY.

Alismaceæ, Alismoideæ Vent. *Juncorum pars.* Juss.—*Alismaceæ, Butomeæ, Podostemmeæ?* Rich.

Herbaceous annual or perennial plants, growing for the most part in humid situations and on the banks of stagnant waters and of rivulets. Their leaves are petioled, sheathing at their base. Their flowers hermaphrodite, seldom unisexual, are disposed in spikes, in panicles, or in sertules. Their calyx, which is wanting in the genus lilæa, is formed of six sepals, of which the three inner are generally coloured and petaloid. The stamina vary in number from six to thirty. The pistils are united many together in each flower, and remain distinct or are more or less united. Their ovary, which is one-celled, contains one, two, or a great number of ovules, erect, pendant, or fixed to the inner side. The fruits are small carpels, dry, generally indehiscent. Their seeds ascending or reversed consist of a proper integument, which immediately covers a large embryo, either straight or curved in the form of a horse shoe.

We unite here in one the three families which my father had established under the names of alismaceæ, juncagineæ, and butomeæ; but which he was himself, however, not far from con-

sidering as three natural sections of the same family. He is the first who has well explained the structure of the ovary and of the embryo in these three groups, which here become sections of the same family. Thus we shall divide the alismaceæ into three sections, to wit:

1st. The juncagineæ, which have the calyx uniform, none in the genus lilæa, one or two seeds erect, and a straight embryo. Such are the genera, lilæa, triglochin, and scheuchzeria.

2d. The alismeæ, which have the calyx semipetaloid, one or two sutural seeds, erect or ascending; an embryo erect or curved in the shape of a horse shoe. Sagittaria, alisma, damasonium.

Butomeæ, whose calyx is semipetaloid; the seeds numerous, attached to veins which adhere to the interior of each cell, and the embryo straight or curved in the form of a horse shoe. The mode of attachment of the seeds is very singular in this tribe, and occurs very rarely. The family of the flacourtianeæ in the dicotyledons, furnishes a second example of it. The genera which form the butomeæ are butomus, hydrocleis and limnocharis.

The family of the alismaceæ has much affinity to the nayades, particularly in their embryo destitute of albumen. But the seed of the nayades is reversed, and that of the alismaceæ is erect; the radicle is turned towards the hilum in the latter, and is opposite to it in the former. Besides, the structure of the flowers presents very great differences. As to the junceæ, of which the alismaceæ originally formed a part, the latter differ from them particularly by their embryo without albumen, while the junceæ have it invariably.

Perhaps we should place here the family of the podostemeæ mentioned by my father, and which differs from the juncagineæ only by its many-seeded capsule.

Translator's Note.—The powdered root of alisma plantago, or water plantain, in half drachm or drachm doses, has

been represented as a specific for the cure of hydrophobia. But facts are as yet wanting to establish its claim to this important property.

TWENTY FOURTH FAMILY.

Colchicaceæ. De Cand.—*Juncorum pars.* Juss.

Herbaceous plants having a fibrous or bulbous root, bearing alternate sheathing leaves. The flowers are terminal, hermaphrodite, or unisexual. The calyx is coloured, with six very deep divisions, sometimes tubular at its base. The stamina, which are six, are opposite to the divisions of the calyx. The ovaries are three in each flower, sometimes free, sometimes more or less united so as to represent a three-celled ovary. Each of them contains a great number of ovules attached to its inner angle. The summit of each ovary bears a style, sometimes very long, terminating in a glandular stigma. The fruit consists of three distinct carpels, opening by a longitudinal suture on the inside. Sometimes the three carpels are united, and form a three-celled capsule, but are separated again when ripe, and open, each by a suture placed at its inner angle. The seeds consist of a reticulated or membranous integument, surmounted sometimes, towards the hilum, by a more or less voluminous tubercle; of a fleshy albumen, which contains a cylindrical em-

bryo placed towards the point opposite to the hilum.

This family stands between the junceæ, of which it was formerly a part, and the liliaceæ. It is distinguished from the former by its coloured calyx, and its capsules either distinct or separating at maturity. The latter character, together with the three styles and the integument of the seed membranous and never crustaceous, distinguishes the colchiceæ from the liliaceæ.

The principal genera of this family are: colchicum, narthecium, veratrum, merendera, melanthium, bulbocodium, &c.

Translator's Note.—Three of the plants belonging to this family are known to contain a principle which acts with great violence on the mucous membrane. This principle is veratria, and has derived its name from the veratrum sabadilla, in whose seeds it was first discovered. The other two are veratrum album, and colchicum autumnale. Preparations of their bulbs and seeds are said to produce very beneficial effects in gout and rheumatism. Meadow saffron is known to have been the active ingredient in the eau medicinale, a quack medicine which has enjoyed great celebrity as a cure for the gout. Hermodactyllus, which was employed in the sixth century by Alexander of Tralles in the treatment of the same disease, is now ascertained to be a species of colchicum. In this family we have a striking example of plants agreeing in chemical composition, and in their effects on the animal economy, which agree in their botanical characters.

TWENTY-FIFTH FAMILY.

Asparagineæ. Asparagorum pars. Juss.—*Smilaceæ.*—R. Brown.

Herbaceous, perennial, or frutescent plants, with a fibrous root and leaves alternate, opposite

or verticillated, sometimes very small and under the form of scales. The flowers sometimes unisexual and variously disposed. Their calyx, often coloured and petaloid, presents six or eight divisions more or less deep, spreading or erect; the stamina of the same number with the calycine divisions at the base of which they are inserted. Their filaments are free, seldom monadelphous. The ovary is free, of three cells, rarely of one cell, containing each one or more ovules inserted at its inner angle. The style is sometimes simple, surmounted by a three-celled stigma, or else it is three-parted, and each division bears a stigma. The fruit is a three-lobed capsule or a globular berry, sometimes one-celled and one-seeded from abortion. The seeds, besides their proper integument, consist of a fleshy or horny endosperm, containing in a cavity, which is sometimes very large and placed near the hilum, a very small embryo.

The family of the asparagineæ, such as we have now delineated its characters, differs from that which M. De Jussieu had established in his genera plantarum. Mr. R. Brown has very justly removed from this the genera with inferior ovary, of which he has made a distinct family under the name of dioscoreæ. The same botanist unites to the asphodeleæ a great number of genera belonging to the asparagineæ, leaving in this family, which he calls smilaceæ, only the genera whose style is deeply trifid, or which bear three or four distinct styles. Such as we have above characterized it, the family of the asparagineæ forms two natural sections or tribes.

1st. The true asparagineæ, whose stigma is simple or three lobed. Dracæna, cordyline, dianella, asparagus, callixene, lapageria, convallaria, polygonatum, maianthemum, ruscus, smilax, &c.

2d. The Parideæ with three or four distinct stigmas.

Paris, trillium, medeola, &c.

Translator's Note.—The young buds and roots of the asparagus officinalis, and the roots of ruscus aculeatus, have diuretic properties. Sarsaparilla is diaphoretic, but only in a slight degree. The roots of the plants which compose this family exhibit a remarkable uniformity in their chemical composition, and in their action on the animal economy. They are all more or less mucilaginous, being chiefly composed of gum and fecula, and appear to exert a slightly stimulant action on the organs which secrete the urine. There is no poison in this family.

TWENTY-SIXTH FAMILY.

Liliaceæ. Lilia et Asphodeli.—Juss. *Hemerocallideæ.*—Brown.

Plants with a bulbiferous or fibrous root. Their leaves, sometimes all radical, are flat, or cylindrical, and hollow, or thick and fleshy. The stem or scape is in general naked; it seldom bears leaves. The flowers are sometimes solitary and terminal, sometimes in simple spikes, in branched racemes or in sertules. They are sometimes accompanied by a spathe, which encloses them before expansion. The calyx is coloured and petaloid, formed of six sepals, either distinct or united at their base, and forming sometimes a tubular calyx.

These six sepals are disposed in two rows, three forming an inner row and three an outer. The number of stamina is six, inserted at the base of the sepals when these are distinct, or at the top of the tube when united. The ovary is three-celled, and has three projecting angles. Each of them contains a variable number of ovules, attached to its inner angle and disposed in two rows. The style is simple or none, terminated by a three-lobed stigma. The fruit is a three-celled capsule, opening by three valves, bearing partitions on the middle of their inner surface. Their seeds are covered with an integument, sometimes black and crustaceous, sometimes simply membranous. Their albumen is fleshy, and contains a cylindrical embryo, whose radicle is turned towards the hilum: rarely this embryo is turned upon itself.

We unite here in one group the two families established by M. de Jussieu, under the names of liliaceæ and asphodeleæ, and the hemerocallideæ of Mr. Brown. In fact the two first families had absolutely the same organization in all their parts, and the only difference between them consisted solely in their mode of germination. Thus, in the asphodeleæ, the cotyledon remains within the seed by one of its extremities, and forms a filiform production, which pushes forth the gemmule. This character, together with a few differences in the port, differences which practice alone enables us to appreciate, are the only signs which distinguish the asphodeleæ from the liliaceæ. We have therefore thought proper to unite them.

As to the hemerocallideæ of R. Brown, they cannot form a distinct family, because their only essential character should consist in a calyx, tubular at the base. This group had been established by the celebrated English botanist for the genera which have a free ovary belonging to the family narcisseæ of Juss, such as hemerocallis, tubalgia, blandfortia.

The insertion presents some differences in the genera which compose the liliaceæ. Thus, while the stamina are attached to the calyx in a great number of genera, and in particular in the hyacinth, lachenalia, asphodel, &c., and therefore perigynous, they are surely hypogynous in the lily, allium, aloe, tritoma, &c.

Translator's Note.—With the exception of the genus aloe, the active principles of the plants belonging to this family reside in their bulbs. We find them in the leaves of the aloe; but the bulbs of the squill, for instance, and the leaves of the aloe, are perfectly analogous organs; for bulbs are considered as subterraneous unexpanded leaves. The bulbs of the liliaceæ usually contain a mixture of a mild, gummy, extractive substance, which is bitter, and of a volatile acrid principle, which is dissipated by heat. The proportion of the latter is diminished by cultivation, and the bulbs are thereby adapted to become articles of food.

TWENTY-SEVENTH FAMILY.

Bromeliaceæ. Juss.

The bromeliaceæ are perennial, parasitical plants. Their leaves are alternate, and in general united in clusters at the base of the stem. They are long, narrow, and often toothed, and bearing spines upon their edges. In a great number of

species the whole plant is covered with a kind of ferruginous down. The flowers form scaly spikes, branched racemes, or capitules, on which they stand so close that they are ultimately united. In a small number of species, the flowers are terminal and solitary. Their calyx is tubular, sometimes adhering at its base, sometimes quite free. The limbus presents six divisions more or less deep, placed in two rows, of which the three inner are coloured and petaloid. The number of stamina is in general six, seldom more. The ovary has three cells, in each of which is inserted a great number of ovules. The style is terminated by a stigma of three flat or awl-shaped divisions. The fruit is generally a berry, crowned by the lobes of the calyx, of three many-seeded cells. Sometimes all the berries of the same spike are united together, and form a single fruit, as in the ananas (pine apple.) More rarely the fruit is dry and dehiscent. The seeds consist of a farinaceous albumen, at the lower part of which is placed an oblong, curved embryo.

We divide the genera of this family into two tribes.

1st. The tillandsieæ, ovary free, tillandsia, pitcarnia.

2d. The bromeliaceæ, ovary inferior, xerophyta, guzmannia, achmea, bromelia, agave, furcræa, &c.

The family of the bromeliaceæ has great affinity to that of the narcisseæ, particularly by its genera with an inferior ovary, forming the tribe of the true bromeliaceæ; but it differs from them by its calyx, whose divisions are placed in two rows,

by its fleshy fruit, and particularly by the port of the vegetables which compose it.

TRANSLATOR'S NOTES.—This family is chiefly remarkable for containing the pine apple, (bromelia ananas,) which is the most delicious of all known fruits. It is a native of South America, and is cultivated in our hot-houses. Its expressed juice yields, by fermentation, a strong alcoholic liquor, which is stimulant and diuretic.

From the leaves of Agave Americana, another plant belonging to this family, is prepared an extract in Spain, which has the properties of the extract of aloes, and which is substituted for it in commerce.

FOURTH CLASS.

MONOEPIGYNY.

TWENTY-EIGHTH FAMILY.

Dioscoreæ.—R. BROWN.

THE Dioscoreæ are often sarmentaceous climbing plants. Their leaves are alternate or sometimes opposite, with irregularly ramified nerves. Their flowers are hermaphrodite or unisexual. Their inferior ovary adheres to a calyx, whose limb is divided into six equal lobes. The stamina, whose number is six, are free or rarely monadelphous, having their anthers introrse. The ovary is three-celled, containing each one, two, or a greater number of ovules, which are sometimes ascending, sometimes reversed. The fruit is a thin compressed capsule, or a globular berry,

sometimes oblong, crowned by the limb of the calyx, and having from one to three cells. The seeds contain an embryo placed towards the hilum in the interior of an almost horny albumen.

This little family has been established by R. Brown, to receive the genera of the family Asparagineæ of Jussieu, whose ovary is inferior—such as Dioscorea, Tamus, Rajania, Fluggea, &c.

Translator's Note.—The root of the tamus communis (black bryony) is almost wholly composed of fecula, and is moreover slightly bitter and acrid. When these qualities are removed by repeated washings and roasting, it may be applied to the same purposes as fecula derived from other sources.

The roots of Dioscorea (the yam,) which are large, thick and fleshy, are extensively used as an article of food in the Indies, in parts of America, and in most of the isles of the Southern Ocean.

TWENTY-NINTH FAMILY.

Narcisseæ, Amarillideæ.—R. Brown. *Narcissorum Genera.*—Juss.

Plants with a bulbiferous or fibrous root and radical leaves; with solitary flowers, often very large, or disposed in sertules or in simple umbels, enclosed before their expansion in scarious spathes. The calyx is monosepalous, tubular, adhering by its base to the inferior ovary, with six equal or unequal divisions. The stamina, six in number, have their filaments free, or united by a membrane.

The ovary is three-celled, many-seeded, the style simple and the stigma three-lobed. The fruit is a capsule of three cells, and three septiferous valves. Sometimes it is a berry, which, by abortion, contains only from one to three seeds. The latter, which often have a cellular caruncula, contain in a fleshy albumen a cylindrical and homotrope embryo.

R. Brown has divided the family Narcisseæ of Jussieu into two natural orders, the hemerocallideæ, in which he has placed the genera with a free ovary, and the Amaryllideæ, which are the true Narcisseæ, with an inferior ovary. We have already united the hemerocallideæ with the lilies. The genera which compose the true narcisseæ are, Narcissus, Amaryllis, Pancratium, Leucoium, Galanthus, &c.

The same English Botanist has also removed from the narcisseæ of Jussieu the genus hypoxis, of which he has made a group under the name of hypoxideæ, which appears to us to differ little from the true narcisseæ. M. Kunth has also withdrawn from this family the genus Pontederia, which, with heteranthera, forms the family Pontederiaceæ, whose characters we have already delineated.

Translator's Note.—The bulbs of these plants are more or less acrid, and, in small doses, they will act as emetics. The flowers of the Daffodil (Narcissus Pseudonarcissus) are considered as antispasmodic. They are looked upon by some as a kind of specific in the treatment of hooping cough. Their extract is the best preparation, and should be administered only in small doses, as two or three drachms of it are sufficient to destroy life in a few hours. The following are the words of Laennec, in speaking of its effects in hooping cough. "I have used this extract much, and have occasionally seen it effect surprisingly rapid cures, for instance in five or six days; but this

result is rare, and as a general remedy, I find it much less efficacious than Belladonna." Half a grain, a grain, or two grains, are given every two, four, or six hours, according to the patient's strength. Its mode of operation is imperfectly known.

THIRTIETH FAMILY.

Irideæ.—Juss.

A very natural family, composed of vegetables usually herbaceous, with a tuberous fleshy root, seldom fibrous. Their stem is cylindrical or compressed, bearing alternate flat ensiform leaves. Their flowers, which are often very large, are enveloped before their expansion in a membranous, thin, scarious spathe. These flowers are solitary, or variously grouped. Their calyx is coloured, tubular, of six deep divisions, disposed in two rows, and often unequal. The stamina, whose number is always three, are either free or monadelphous, opposite to the outer divisions of the calyx. The ovary consists of three, many-seeded cells. The style is simple, terminated by three simple stigmas, bifid or lobed, and in the form of thin, petaloid plates. The fruit is a three-celled capsule, opening by three septiferous valves. The seeds are composed of a proper integument, and of a cylindrical, homotrope embryo, placed in a fleshy or horny albumen.

This family, composed of a great number of genera, is di-

vided into two sections, accordingly as the genera have their stamina free or monadelphous To the first belong the genera Iris, Ixia, gladiolus, crocus, antholyza, watsonia, &c. In the second we have sisyrinchium, galaxia, tigridia, vieusseuxia, ferraria, &c.

The irideæ are easily distinguished by their inferior ovary, and by their stamina, which are always three.

Translator's Note.—The crocus alone, of all the plants belonging to this family, produces odorous stigmata; but there is great uniformity in the properties of their roots, as they all contain fecula and an acrid principle, by which they act with considerable energy on the parts of the body with which they come in contact. Thus the roots of the iris germanica and pseudacorus have been used as purgatives and emetics, and that of the J. Florentina, on account of its acrimony and agreeable odour, has been employed as a means of keeping up the discharge from issues.

THIRTY-FIRST FAMILY.

Hæmodoraceæ.—R. Brown.

The Hemodoraceæ are herbaceous, perennial plants, sometimes without a stem, having simple leaves in two opposite rows, and sheathing at their base; flowers disposed in corymbs or in spikes. The calyx is monosepalous, of six deep divisions, adhering by its base to the inferior ovary, except the genus Wachendorfia. The stamina inserted on the calyx, are six or three in number. In the latter case they are opposite to the inner divisions. The ovary has three cells,

each of which contains one, two, or several ovules. The style and the stigma are simple. The fruit is a capsule, sometimes indehiscent, or opening either at its top or by means of valves. The seeds contain a very small embryo in a rather hard albumen.

This little family, by its port, approaches very nearly to the irideæ; but differs from them by its stamina, whose number is six, or when there are only three, by its stamina opposite to the inner divisions of the calyx, and not to the outer, as in the irideæ. It differs from them also by its stigma, which is always simple. The genera dilatris, lanaria, heritiera, wachendorfia, hœmodorum, conostylis, anigozanthos, phlebocarya, compose this family.

THIRTY-SECOND FAMILY.

Musaceæ.—Juss.

Herbaceous, perennial plants, without a stem, sometimes furnished with a stipe or a bulb in the form of a stem. The leaves, which have long petioles, amplexicaul at the base, are very entire. The flowers are very large, often painted with the most vivid colours, united in great numbers, and contained in spathes. Their calyx is coloured, petaloid, irregular, adhering by its base to the ovary. Its limb has six divisions, of which three are outer and three inner. (In the genus musa, five of the divisions are external, and form, as it were, an upper lip, one only is internal, and forms

the lower lip.) The stamina, which are six, are inserted at the inner part of the calycine divisions. The anthers are linear, introrse, two-celled, surmounted in general by a membranous, coloured appendage, which is petaloid and terminates the filament. The inferior ovary is three-celled, each cell containing a great number of ovules, inserted at their inner angle. In the genus heliconia, there is only one ovule growing from the bottom of each cell. The simple style terminates in a stigma, which is sometimes concave; but oftener consists of three lobes or of three segments. The fruit is either a three-celled, many-seeded capsule, having three valves bearing partitions on the middle of their inner surface, or a fleshy indehiscent pericarp. The seeds sometimes borne upon a podosperm, and surrounded with hairs placed circularly, are composed of a sometimes crustaceous integument and of a farinaceous albumen, containing an axile, oblong and erect embryo.

This family is composed of the genera musa, heliconia, strelitzia and urania. Intermediate between the narcisseæ and amomeæ, it differs from the former by its calyx, which is always irregular, and from the latter by its stamina, which are always six.

Translator's Note.—The fruits of the common plantain tree, (musa paradisiaca,) and of the banana tree (musa sapientum,) furnish a wholesome and nutritious food to the inhabitants of the tropical climates of the old and new world. Three

dozen of plantains will serve a man for a week instead of bread, and will support him better. A single plant may produce four dozen of fruits annually. The fruit is eight or nine inches long, and one in diameter, containing a soft pulp of a luscious, sweet flavour. When cultivated, it contains no seeds, and it is, therefore, regarded by M. De Candolle as a monstrosity.

THIRTY-THIRD FAMILY.

Amomeæ—Rich. *Cannæ*—Juss. *Scitamineæ et Cannæ.*—R. Brown. *Drymyorrhizeæ, Vent.*

The amomeæ are perennial plants of a peculiar port, by which they approach a little to the orchideæ. Their root is often tuberous and fleshy; their leaves simple, terminated at their base by a simple or cleft sheath, and sometimes furnished with a ligula. Their flowers, rarely solitary, are accompanied with pretty large bracteas, and, in general, form dense or panicled spikes. Their calyx is double. The outer, which is sometimes tubular and shorter, is of three equal divisions. The inner has a double limb. The three outer divisions are in general equal. Of the three inner, one is larger and dissimilar, and forms a kind of labellum; the two lateral ones are smaller, and often nearly abortive. There is but one stamen, whose filament is often expanded and as if petaloid. The anther has two cells, sometimes separate and distinct. The ovary has three many-seeded cells. The simple style, terminated by a concave stigma,

has the form of a cup. At the base of the style, on the summit of the ovary, may be seen a small, two-lobed tubercle, which may be regarded as two abortive stamina. The fruit is a three-celled capsule, opening by three valves, bearing each a partition on the middle of its inner surface. The seeds, sometimes accompanied with an arillus, consist of a cylindrical embryo, placed in a farinaceous albumen, and having its radicle turned towards the hilum.

The description we have given of the characters of the family amomeæ is conformable to that which has been published by most authors; but another may be given which is more conformable to natural affinities. Thus the amomeæ, which have the greatest affinity to the musaceæ, may be described as having six stamina, and a perianth of six divisions like the latter. One of these stamina is fertile, the other five are barren. Two are represented by the two-lobed tubercle which stands at the base of the style, and the other three are converted into petaloid appendages, and are represented by the three innermost divisions of the calyx. This description of the flower of the amomeæ is conformable to nature, and in this manner, the family naturally connects itself, on the one hand, with the musaceæ, which are, as it were, its regular type, and on the other, with the orchideæ, in which may be observed similar abortions and transformations. M. Lestiboudois, Professor of Botany at Lille, has first called the attention of botanists to the structure of the flower of the amomeæ; but we are far from adopting his opinion when he thinks that this family ought to be united with the musaceæ.

Mr. Brown has proposed to separate some genera from the amomeæ, such as canna, maranta, thalia, phrynium, and my-

rosma, for the purpose of forming of them a distinct family under the name of canneæ.

Besides the above mentioned genera, the amomeæ contain amomum, zingiber, hellenia, costus, &c.

Translator's Note.—There is a remarkable uniformity in the properties of the plants belonging to this family. An essential oil is found in almost all parts of the plant. The root abounds moreover with fecula and colouring matter. From the root of one species (maranta arundinacea) the fecula is extracted and sold under the name of arrow root. The colouring matter of curcuma longa is used as a test for alkalis, and is known by the name of turmeric. The roots and seeds, on account of their essential oil, are used in medicine.

THIRTY-FOURTH FAMILY.

Orchideæ.—Juss.

Perennial plants, sometimes parasitical upon other vegetables, having a root composed of simple cylindrical fibres, often accompanied with one or two fleshy tubercles, ovate or globular, entire or digitate. The leaves are always simple, alternate sheathing. The flowers often very large and of a peculiar form, are solitary, fasciculated, spiked, or panicled. The calyx has six deep divisions, of which three are inner and three outer. The latter, often similar to each other, are either spreading or in contact at the upper part of the flower, where they form a kind of helmet (calyx galeatus.) Of the three inner divisions, two are lateral, superior, and

similar to each other; one is inferior, of a peculiar figure, and bears the name of labellum, or lip. At its base it sometimes presents a hollow prolongation called spur (labellum calcaratum.) From the centre of the flower there arises on the top of the ovary a kind of columella called gynosteme, which results from the union of the style with the filaments, and which bears on its anterior and upper surface a glandular depression, which is the stigma, and at its summit a two-celled anther, opening either by a longitudinal suture, or by a lid, which forms the whole of its upper part. The pollen contained in each cell of the anther, is united into a mass which has the same form with the cavity that contains it. At the top of the gynosteme, at each side of the anther, there are found two small tubercles, which are two abortive stamina, and which are called staminodia. These two stamina are developed in the genus cypripedium, while that of the middle is abortive. The fruit is a one-celled capsule, containing a great number of very small seeds, attached to three parietal trophosperms, projecting and two forked at the inner side. These seeds have their outer integument formed of a slight net work, and consist of an albumen containing a very small axile and homotrope embryo.

This family which may be regarded as one of the most na-

tural of the vegetable kingdom, presents such remarkable peculiarities in the structure of its flowers, that it cannot be confounded with any other. The union of the stamina with the style and stigma, and particularly the organization of the pollen united into a mass (a character which is observed only in the asclepiadeæ, and in some mimosæ of the dicotyledonous plants,) are the most striking distinctive characters of this family. The masses of pollen present, in their composition, three principal modifications, which have served to establish three tribes in the family of the orchideæ. Sometimes they are formed of pretty large granules, united together by the means of a viscid matter, which, on trying to separate them, is drawn out in the form of elastic filaments. These masses of pollen have received the name of sectile masses. They characterize the first tribe, or that of the ophrydeæ, which contains, among other genera, orchis, ophrys, satyrium, serapias, habenaria, &c. Sometimes the masses of pollen are pulverulent, that is to say, formed of a kind of pultaceous matter, which is observed in the second tribe or that of the limodoreæ, which contains the genera, limodorum, epipactis, &c. Lastly, each mass of pollen may be formed of granules so coherent and confounded together, that it appears to be composed of wax. In this case, which is observed in the third tribe, they are said to be solid. Ex: epidendrum, angræcum, malaxis, liparis, &c.

The masses of pollen are sometimes prolonged at their lower part into a filiform appendage called caudicle, which often terminates in a viscid gland of various forms called retinaculum. The number of these masses of pollen varies from one to four for each cell of the anther. The latter is placed at the anterior and upper surface of the gynosteme, from which it is not distinct, as in the tribe of the ophrydeæ. Sometimes it is placed in a kind of depression which terminates the gynosteme at its summit, and which is called clinandrium, and it opens and is removed like a sort of lid (anthera operculiformis,) as in almost all the genera of the two other tribes, &c.

Translator's Note.—From the root of the orchis mascula is prepared a nutritious substance, which is known by the name of salep. It consists almost entirely of bassorin, together with a small quantity of gum and starch. The same substance might be obtained from the roots of the other species.

The fruit of the epidendrum vanilla is highly aromatic, and is used for the purpose of communicating its odour to chocolate.

THIRTY-FIFTH FAMILY.

Hydrocharideæ.—Juss.

Aquatic herbs having the cauline leaves entire or finely toothed, sometimes spread on the surface of the water. The flowers contained in spathes are, in general, diœcious, very rarely hermaphrodite. The male flowers, usually united many together, are sometimes sessile, sometimes pedicelled. With respect to the female or hermaphrodite flowers, they are always sessile, or contained in a one-flowered spathe. The calyx is always of six divisions, of which the three inner are petaloid, the three outer not. The number of stamina varies from one to thirteen.

The ovary is inferior, sometimes contracted at its upper part into a filiform prolongation, which rises above the spathe and occupies the place of a style. The stigmas are from three to six in number, bifid or bipartite, rarely simple. The fruit is fleshy within, having a simple cavity, or divided by membranous partitions into as many cells as

there are stigmas. The seeds, which are numerous and covered by a kind of pulp, are erect, having a proper membranous integument, which is very thin, immediately covering the embryo, which is straight and cylindrical.

Among the genera which compose this family, we shall mention valisneria, stratiotes, hydrocharis, limnobium, ottelia, &c.

This family is well characterised by its inferior ovary, its divided stigmas, the internal structure of its fruit, which is the same with that of the cucurbitaceæ, and its embryo without any albumen.

THIRTY-SIXTH FAMILY.

Nymphæaceæ.—Salisb.

Large and beautiful plants, which float on the surface of the water, and whose stem forms a subterraneous creeping stock. Their alternate, entire leaves, are cordiform or orbicular, borne upon very long petioles. Their flowers are very large, solitary, and supported upon very long cylindrical peduncles. The calyx is formed of a number of sepals, which is variable, sometimes very great, disposed in several rows, so as to represent a calyx and polypetalous corolla. The stamina are very numerous, inserted in many rows under the ovary, or even on its outer-wall, which is thus covered by stamina and by the inner se-

pals, which are probably nothing but transformed stamina, as may be inferred from the gradual dilatation of the filaments as they approach the circumference. The anthers are introrse and have two linear cells. The ovary is free and sessile at the bottom of the flower, divided within into many cells by membranous dissepiments, on whose walls are inserted numerous pendent ovules. The summit is crowned by as many radiating stigmas as there are cells in the ovary. The union of these stigmas forms a kind of disc which crowns the ovary. The fruit is indehiscent and fleshy within, of several many-seeded cells. The seeds have a thick integument, sometimes developed in the form of a net work, containing a large farinaceous albumen, which bears on its summit an embryo irregularly globular or napiform, whose radicle is turned towards the hilum. The cotyledon is thin, under the form of a peculiar integument covering the gemmule, which is two-lobed.

This family, which consists of the genera nymphæa and nuphar, is even now a subject of controversy among botanists, some placing it among the monocotyledons, and others among the dicotyledons near the poppies; but the structure of the embryo and the germination are surely those of monocotyledonous plants (v. xii. tom. of the Classical Dictionary of Natural History, the article Nymphæaceæ, where we carefully discuss these different opinions.) We conclude the article here cited with the following observation: ought the genus nelumbium to be left in the family of the nymphæaceæ, or is it to

be made the type of a distinct family? As yet we do not dare to resolve this question. The port is absolutely the same, and it may appear very strange to separate as distinct orders two genera, which, according to some botanists, at the head of whom stands Linnæus, ought to be united in the same genus. But we ask, on the other hand, can we admit into the same family two genera, of which one has a simple ovary of several many-seeded cells, surmounted by as many stigmas as there are cells, and whose numerous ovules are attached to the whole extent of the walls of the dissepiments, and of which the other, having at the centre of its flower a very large receptacle or torus in the shape of an inverted cone, presents a great number of distinct one-celled and one-seeded pistils inserted in depressions on the upper surface of that receptacle: two genera, one of which is possessed of a very large, fleshy albumen, which is wholly wanting in the other. These differences appear to us so important, that we are disposed to consider them as sufficient to establish two distinct families, which, however, should remain near one another.

Translator's Note.—The genus nelumbium, respecting whose classification our author expresses a doubt, was made a species of nymphæa, by Linnæus. It is conjectured by Sir Jas. E. Smyth, to have been the sacred bean of the ancients, the use of which was prohibited to his followers by Pythagoras. He, therefore, proposes to call it cyamus. At present it is held sacred by the Chinese and other Eastern nations, by whom it is cultivated as an article of food. It is celebrated in their songs, and served up as a delicacy at all their festivals. The parts used are the roots and the seeds. It it a native of the East and West Indies, of China, Japan, Persia, and some parts of the Russian Empire.

In Sweden the roots of the nuphar lutea are, in times of scarcity, mixed with the inner bark of the pinus sylvestris, for the purpose of making bread. They were formerly thought to be sedative and narcotic.

THIRTY-SEVENTH FAMILY.

Balanophoreæ.—Rich.

A small family, composed of parasitical vegetables of a peculiar port, which has some resemblance to that of the orobancheæ, and which, like them, live always adhering to the roots of other vegetables. Their stem, destitute of leaves, is either covered with scales or naked. The flowers are monœcious, forming very dense ovate spikes. In the male flowers the calyx consists of three deep divisions, equal and spreading; rarely a simple scale occupies the place of the calyx. The number of stamina is from one to three, seldom more. They are united both by their anthers and their filaments. In the female flower, the ovary is inferior, one-celled, containing a single reversed ovule. The limb of the calyx which crowns the ovary is entire, or formed of two to four unequal divisions. There is one or two filiform styles terminated by as many simple stigmas. The fruit is a globular, umbilicated caryopsis. The seed contains a very small globular embryo, placed in a small, superficial depression of a very large, fleshy albumen.

The genera which compose this little family are, helosis langsdorphia, cynomorium and balanophora. It has affinities to the aroideæ and hydrocharideæ.

II. Of Dicotyledonous Plants.

They are all those whose embryo presents two cotyledons. In one family only, that of the coniferæ, there are often found from three to ten verticillated cotyledons.

The internal organization of the stem, all whose parts are disposed in concentric layers, the disposition and ramification of the nerves, the number five or one of its multiples in almost all the parts of the flower, the very frequent presence of a calyx and of a corolla, and lastly the port, so different from that of monocotyledons, are the principal marks by which to distinguish dicotyledonous from monocotyledonous vegetables.

The dicotyledons have been, in the first instance, divided into apetalous, monopetalous, polypetalous and diclinous.

I. Apetalous Dicotyledons.

FITFH CLASS.

EPISTAMINY.

THIRTY-EIGHTH FAMILY.

ARISTOLOCHIEÆ.

A family composed of two genera only, aris-

tolochia and asarum.* They are herbaceous or frutescent and twining plants, bearing alternate entire leaves and axillary flowers. Their calyx is regular, of three valvar divisions, or irregular, tubular, and forming a lip or thong of a very variable figure. The number of stamina is six or twelve, inserted on the ovary. They are sometimes free and distinct, sometimes united intimately with the style and stigma, and thus form a kind of protuberance on the top of the ovary. On its lateral surfaces, this protuberance bears the six stamina which are two-celled, and at its summit it is terminated by six small lobes, which may be considered as stigmas. The fruit is a capsule or berry of three to six cells, containing each a great number of seeds, enclosing a very small embryo placed in a fleshy albumen.

In addition to the above, M. de Jussieu had united to this family the genus Cytinus, which is become the type of a distinct family under the name of Cytineæ.

THIRTY-NINTH FAMILY.

Cytineæ.—R. Brown.

Their flowers are unisexual, monœcious or diœcious. Their calyx is adherent, rarely free. (Nepenthes.) Its limb is of four or five divi-

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* Mr. Robert Brown cites as a part of this family, which he calls Azarineæ, the genera Thottea and Bragantia.

sions. The stamina vary from eight to sixteen ; sometimes they are more. They are extrose and monadelphous. The ovary is inferior, except in nepenthes, of one to four cells; the seeds are attached to parietal placentas. The style is cylindrical, rarely none, terminated by a stigma, whose lobes are equal in number to that of the placentas. The seeds have a cylindrical, axile embryo, placed in the centre of a fleshy albumen.

The genera which compose this family are cytinus, rafflesia and nepenthes. The two first are parasites, and destitute of leaves. The third is remarkable for its leaves, terminated at their top by an utricle which is closed by means of a moveable lid. This family is distinguished from the Aristolochiæ, particularly by its seeds attached to parietal placentas, by its unisexual flowers, and by the number four or five occurring in the different parts of the flower.

Translator's Note—The fruit of cytinus hypocistus is astringent. An extract prepared from it has tonic virtues, but is seldom used.

FORTIETH FAMILY.

Santalaceæ.—R. Brown.

Herbaceous or frutescent plants, or trees with alternate leaves, rarely opposite, without stipules ; with small flowers, either solitary, or disposed in spikes or in sertules. Their calyx is superior, with four or five valvar divisions. The stamina, either

four or five in number, are opposite to the divisions of the calyx and inserted at their base. The ovary is inferior, one-celled, containing one, two, or four ovules, pendent from the top of a filiform podosperm growing and ascending from the bottom of the cell. The style is simple, terminated by a lobed stigma. The fruit is indehiscent, one-seeded, sometimes slightly fleshy. The seed has an axile embryo in a fleshy albumen.

This family, established by R. Brown, is composed of the genera thesium, quinchamalium, osyris, fuzanus, placed by M. de Jussieu in the family of the Elæagneæ, and of the genus santalum, which formed part of the onagrarieæ. It differs from the elæagneæ, particularly by its inferior ovary, containing many pendent ovules, while the latter have a free ovary containing a a single erect ovule. It is also allied to the family of the *combretaceæ*. But the latter is distinguished by its ovules pendent from the top of the cell of the ovary, by its seeds without albumen and by the polypetalous corolla which is observed in some of its genera.

SIXTH CLASS.

PERISTAMINY.

FORTY-FIRST FAMILY.

Elæagnæ.—A. Rich. *Elæagnorum gen.*—Juss.

Trees or shrubs with alternate or opposite leaves, without stipules, and entire. Their flowers are diœcious or hermaphrodite. The male are

sometimes disposed on a kind of catkin. The calyx is monosepalous, tubular; its limb is entire, or has two or three divisions. The stamina from three to eight in number are introse, and almost sessile on the inner wall of the calyx. In the female flowers, the tube of the calyx immediately covers the ovary, but without adhering to it. The entrance of the tube is sometimes partly closed by a disc which is variously lobed. The ovary is free, one-celled, containing a single ascending and pedicelled ovule. The style is short; the stigma is simple, oblong, tongue-shaped. The fruit is a crustaceous akenium covered by the calyx, which is become fleshy. The seed contains, in a very thin albumen, an embryo which has the same direction with itself.

The family of the Elæagneæ, such as it was established by Jussieu, contained very dissimilar genera. Mr. R. Brown has first circumscribed it within better limits, by reducing it to the genera elæagnus and hippophae, to which we have added the two new genera, shepherdia and conuleum, which have all a free and one-seeded ovary. Already M. de Jussieu had withdrawn from the elæagneæ the genera terminalia, bucida, pamea, &c., in order to form the family terminalieæ; but Mr. R. Brown has divided into three families the genera originally united in the elæagneæ, to wit, 1st, the true elæagneæ, such as we have now characterised them. 2ndly, The santalaceæ, which have an inferior ovary and one or more ovules pendent from the top of a basilar podosperm. 3rdly, The combretaceæ, which comprise most of the genera of the terminalieæ of M. de Jussieu, and some genera formerly placed in the onagrarieæ.

FORTY-SECOND FAMILY.

Thymeleæ.—Juss.

Shrubs, rarely herbaceous plants with alternate or opposite leaves, very entire, having the flowers terminal or axillary, in sertules, in spikes, either solitary or united many together in the axilla of the leaves. The calyx is generally coloured and petaloid, more or less tubular, of four or five divisions, imbricated before expansion. In general the number of stamina is eight, disposed in two rows; or only four, or even two. They are inserted on the inner wall of the calyx. The ovary is one-celled, and contains a single pendent ovule. The style is simple, terminated by an equally simple stigma. The fruit is a kind of nut, slightly fleshy on the outside. The embryo, which is reversed like the seed, is contained in a fleshy, thin albumen.

The principal genera of this family are daphne, stellera, passerina, pimelea, struthiola, &c.

Translator's Note.—The barks of these plants contain a green resinous principle, a bitter crystalline substance which is called daphnine, and a yellow colouring matter. They are more or less acrid or corrosive, and most of them are in some degree poisonous.

Their barks have been used externally as a rubefacient, and internally in various diseases as a stimulant, but particularly in constitutional syphilis. They are also used for dying wool yellow; and the inner bark, owing to its great tenacity, serves for making cloth and cordage. In the D. laghetto, the inner bark resembles lace work, and hence the name of lace-wood, by which the plant is distinguished.

FORTY-THIRD FAMILY.

Proteaceæ.—Juss.

The Proteaceæ are all exotic shrubs or trees, which grow in abundance at the Cape of Good Hope and in New Holland. Their leaves are alternate, sometimes almost verticillated or imbricated. Their flowers generally hermaphrodite, and rarely unisexual, are sometimes grouped in the axilla of the leaves, sometimes united in a kind of cone or catkin. Their calix is composed of four linear sepals, sometimes united and forming a tubular calyx of four divisions, which are more or less deep and valvar. The stamina, whose number is four, are opposite to the sepals, and almost sessile at the upper part of their inner surface. The ovary is one-celled, containing a simple ovule attached towards the middle of its height. The style is terminated by an usually simple stigma. The fruits are capsules of various forms, one-celled and one-seeded, opening at one side only by a longitudinal suture, and sometimes so united as to form a cone. The seed, which is sometimes winged, is composed of a straight embryo, destitute of albumen.

The genera of this family are numerous. We shall here cite as examples Protea, Petrophila, Banksia, Grevillea, Embothrium, Hakea, &c.

This family, from the shape of its calyx, from its stamens sessile on the top of the sepals, and above all, from its port, cannot be confounded with any other.

FORTY-FOURTH FAMILY.

Laurineæ.—Juss.

Trees or shrubs with alternate leaves, rarely opposite, entire or lobed, very often coriaceous, persistent and pointed. Their flowers, sometimes unisexual, are disposed in panicles or cymes. The calyx is monosepalous, of four or six deep divisions, imbricated by their edges before expansion. The stamina are eight to twelve in number, inserted at the base of the calyx. At the base of the filaments are two pedicelled appendages of various forms, which appear to be abortive stamina. The anthers are terminal, opening by means of two to four valves, which may be raised from their base towards their summit. The ovary is free, one-celled, containing a single pendent ovule. The style is more or less oblong, terminated by a simple stigma. The fruit is fleshy, accompanied at its base by a calyx which forms a kind of cup. The seed contains, under a proper integument, a very large embryo, reversed like the seed, and having very thick and fleshy cotyledons.

This family has for its type the laurel and some genera which are allied to it, such as borbonia, ocotea, and cassytha.

The latter is remarkable as consisting of herbaceous, twining plants, without leaves. M. de Jussieu had united the nutmeg tree to the Laurineæ; but Mr. R. Brown has very justly withdrawn it from them, in order to make of it a distinct family, by the name of myristiceæ. The family of the Laurineæ is particularly characterised by its port and its stamina, whose anthers open by means of valves. The same character is observed in the hamamelideæ and berberideæ; but the latter family belongs to the class of dicotyledonous, polypetalous, hypogynous plants.

Translator's Note.—There are few families which exhibit a greater uniformity in their properties, and whose products are more interesting, than that of the Laurineæ. They contain in great abundance an aromatic essential oil, which imparts to them that sweet, and sometimes strong and penetrating odour, and the hot and pungent taste, which are observed in the barks of the cinnamon and sassafras, in laurel berries, in the leaves of the malabathrum, in the fruits of the pichurim, and, in short, in all the organs of those vegetables. Not only essential oil, but also camphor, in greater or less proportion, is contained in most of the species of this family. In L. camphora the latter principle abounds more than any other. L. Pichurim, and L. Benzoin yield benzoic acid.

FORTY-FIFTH FAMILY.

Myristiceæ.—R. Brown.

All exotic trees, growing within the tropics, having alternate leaves, not pointed, entire; dioecious flowers, axillary or terminal, variously arranged. Their monosepalous calyx has three valvar divisions. In the male flowers we find from three to twelve monadelphous stamina, whose

contiguous and sometimes united anthers open by a longitudinal groove. In the female flowers, the ovary is free and one-celled, containing a single erect ovule. The style is very short, terminated by a lobed stigma. The fruit is a kind of capsular berry, opening by two valves. The seed is covered by a fleshy arillus, divided into a great number of segments. The albumen is fleshy or very hard, marbled, containing towards its base a very small, erect embryo.

This family has for its type the nutmeg tree. It is very distinct from the laurineæ by its calyx of three divisions, its monadelphous stamina opening by a longitudinal groove, its erect seed, covered with an arillus, its very small embryo contained in a hard and marbled albumen.

Translator's Note.—The fruit of myristica moschata, which is used in medicine, contains a fixed and an essential oil, both of which may be obtained by pressure. They reside in the kernel of the hard brown seed, and in the arillus or mace which covers it. They are both stimulant. In order to obtain the essential oil pure, it must be separated by distillation.

FORTY-SIXTH FAMILY.

Polygoneæ.—Juss.

Herbaceous plants, rarely suffrutescent, with alternate leaves, sheathing at their base, or adhering to a membranous, stipular sheath, revolute on the midrib when young. The flowers sometimes unisexual, disposed in cylindrical spikes, or

in terminal racemes. The calyx monosepalous, having from four to six divisions, sometimes disposed in two rows, and imbricated before expansion. The stamina from four to nine, free and with anthers opening longitudinally. The ovary free, one-celled, having a single erect ovule. The fruit, very often triangular, is dry and indehiscent, sometimes covered by a persistent calyx. The seed contains in a farinaceous albumen, which is sometimes very thin, a reversed and often unilateral embryo.

This family is composed of the genera polygonum, rumex, cocoloba, &c. It is distinguished from the chenopodeæ by the stipular sheath of its leaves, by its erect ovule, and its reversed embryo.

Translator's Note.—This family furnishes a striking example of plants agreeing in chemical composition, which have the same botanical characters. The roots of a great number of its species contain tannin and gallic acid, and are therefore astringent. Thus, in the root of the bistort they form a very large proportion, and in rhubarb they exist in such quantity, as to modify its purgative action, and to make it in some degree astringent. The rhubarb root also contains oxalate of lime, which shews it to agree in composition with several species of rumex, whose leaves abound with binoxalate of potash. Rumex alpinus is slightly purgative, and, therefore, agrees with rhubarb in its action on the animal economy.

The seeds contain a large and farinaceous albumen, which has a mild and agreeable taste. It furnishes a wholesome and nutritious food, and is yielded in great abundance by buck wheat (polygonum fagopyrum.) This is a valuable plant, as it

grows well in impoverished soils. It is, therefore, extensively cultivated in several parts of France.

FORTY-SEVENTH FAMILY.

Chenopedeæ.—D. C. *Atripliceæ.*—Juss.

Herbaceous or woody plants, with alternate or opposite leaves, without stipules. Their flowers are small, sometimes unisexual, disposed either in branched racemes or in groups in the axillæ of the leaves. Their calyx monosepalous, sometimes tubular at its base, is of three, four, or five divisions, more or less deep and persistent. The stamina vary from one to five. They are inserted either at the base of the calyx, or under the ovary. These stamina are opposite to the lobes of the the calyx. The ovary is free, one-seeded, containing a single erect ovule, which is sometimes borne upon a longish and slender podosperm. The style, which is rarely simple, is of two, three, or four divisions, terminated each by an awl-shaped stigma. The fruit is an achenium or a small berry. The seed consists, under its proper integument, of a cylindrical, slender embryo, curved upon a farinaceous albumen, or rolled spirally, and sometimes it has no albumen.

This family is composed of the genera chenopodium, atriplex, salsola, beta, salicornia, &c. It has on the one hand a close affinity to the polygoneæ, which differ from it by the

stipular sheath of their leaves, by their embryo not curved, and by their superior radicle. It has on the other hand a close resemblance to the amaranthaceæ, from which it really differs only in port and in some other characters of little value. The chenopodeæ furnish an example of some genera with a perigynous insertion, as beta, blitum, spinacia, and of others in greater number, which have their insertion hypogynous, such as rivinia, salsola, camphorosma, chenopodium, &c.

Mr. R. Brown has proposed to separate the genus phytolacca from the chenopodeæ, in order to make it the type of a distinct family, under the name of phytolacceæ. This family, which to us appears not to be very distinct, differs by its ovaries being grouped to the number of ten or twelve, and united into a single fruit.

Translator's Note.—The plants of this family are sweet, mucilaginous, and saccharine. A few, such as camphorosma, are more or less acrid and odorous. Salsola kali, chenopodium, setigerum, and salicornia herbacea, with several other species of this family, yield carbonate of soda, and they are the plants from which it is actually prepared in Spain. Beet root (beta vulgaris) contains a large quantity sugar.

SEVENTH CLASS.

HYPOSTAMINY.

FORTY-EIGHTH FAMILY.

Amaranthaceæ.—R. Brown. *Amaranthacearum pars.*—Juss.

The amaranthaceæ are herbaceous or suffrutescent plants, bearing alternate or opposite leaves,

sometimes furnished with scarious stipules. The flowers are small, often hermaphrodite, sometimes unisexual, disposed in spikes, in panicles, or in capitules, and furnished with scales which separate them. The calyx is monosepalous, often persistent, with four or five deep divisions. The stamina vary from three to five. Their filaments are sometimes free, sometimes monadelphous, and sometimes they form a membranous tube, lobed at its summit, and bearing the anthers on its inner surface. The ovary is free, one-celled, containing a single erect ovule, which is sometimes borne upon a very long and curved podosperm, at the top of which it is pendent. The style is simple or none, terminated by two or three stigmas. The fruit, in general surrounded by the calyx, is an achenium or a small pyxidium, opening by a lid. The embryo is cylindrical, oblong, and curved round a farinaceous albumen.

This family, composed, among others, of the genera amaranthus, celosia, gomphrena, achyranthes, &c. is so nearly allied to the chenopodeæ, that it is extremely difficult to draw the line that separates them. In fact the insertion, which is, in general, perigynous in the chenopodeæ, is also hypogynous in many of their genera, as we have already remarked; but the port of these two families is perfectly different. The stamina are often monadelphous in the amaranthaceæ, which have also their leaves sometimes opposite. But although these distinctive characters are of little value, yet it is difficult to unite two families, which appear so perfectly distinct when we con-

sider only their port. From the amaranthaceæ have been separated certain genera with perigynous stamens, such as illecebrum, paronychia, &c., which united with a few others taken from the caryophylleæ form a distinct family under the name paronychieæ.

FORTY-NINTH FAMILY.

Nyctagineæ.—Juss.

The Nyctagineæ are herbaceous plants, shrubs or even trees, whose leaves are simple, usually opposite, sometimes alternate. The flowers are axillary or terminal, often united many together in a common involucre, or having each a proper involucre of the shape of a calyx. Their calyx is monosepalous, coloured, often tubular, swelled at its lower part, which is often thicker and persistent after the fall of the upper part. The limb is more or less divided into folded lobes. The stamina vary from five to ten, and are inserted on the upper edge of a kind of hypogynous disc, often of the shape of a cup. The ovary is one-celled, containing an erect ovule. The style and stigma are simple. The fruit is a caryopse covered by the disc and the lower part of the calyx, which are crustaceous and form a sort of accessory pericarp. The true pericarp is thin, adhering to the proper integument of the seed. The latter consists of an embryo curved on itself, having its radicle folded

on the face of one of the cotyledons, and thus embracing the albumen, which is in the centre.

The genera Nyctago, Allionia, Pisonia, Boerhavia, &c. belong to this family. Some authors, considering those genera only whose involucre contains but one flower, have admitted this involucre as a calyx, and the calyx as a corolla; but analogy, and particularly the genera with a many-flowered involucre, prove that the perianth is truly simple.

TRANSLATOR'S NOTE.—The marvel of Peru (Nyctago hortensis) was long supposed to be the plant that yields the jalap root, which is now known to be obtained from a species of convolvulus. Its root possesses the same qualities as that of jalap, but in a slighter degree.

EIGHTH CLASS.

HYPOCOROLLY.

FIFTIETH FAMILY.

Plantagineæ.—JUSS.

A SMALL family of plants composed exclusively of the genera plantago and littorella, and which are known by the following characters. The flowers are hermaphrodite, unisexual in the genus littorella only, forming simple, cylindrical spikes, oblong or globular; the flowers are rarely solitary. The calyx is of four deep and persistent divisions, or of four unequal sepals, of the form of scales, and of which two are exterior. The

corolla is monopetalous, tubular, of four regular divisions, rarely entire at its summit. This corolla in the genus plantago gives attachment to four projecting stamina, which in littorella grow from the receptacle. The ovary is free, of one, two, or very rarely of four cells, containing one or more ovules. The style is capillary, terminated by a simple, awl-shaped stigma, rarely bifid at its summit. The fruit is a small pyxidium, covered by a persistent corolla. The seeds are composed of a proper integument, which covers a fleshy albumen, in the centre of which is a cylindrical embryo, which is axile and homotrope.

The plantagineæ are herbaceous plants, rarely suffrutescent, often without a stem, and having only radical peduncles, which bear spikes of very dense flowers. Their leaves are often radical, entire, toothed or variously incised. They grow almost in all latitudes. Jussieu, and most other botanists, consider the plantagineæ as truly apetalous. With this illustrious botanist the organ which we have described as a corolla is a calyx, and our calyx is a collection of bracteas; but it appears to us that the constancy and regularity of these two organs entitle them to be considered rather as a double perianth, as has been recently admitted by the celebrated R. Brown.

The plantagineæ are very nearly allied to the plumbagineæ, from which they differ particularly by their style, which is always simple, by their ovary, which is two-celled, and often many-seeded, while it is always one-celled, and contains an ovule pendent from the top of a basilar and erect podosperm in the plumbagineæ.

Translator's Note.—The seeds of these plants contain a large quantity of mucilage, which they readily yield to hot water. They are, therefore, emollient, and have been employed for the same purposes as linseed and mallows.

FIFTY-FIRST FAMILY.

Plumbagineæ.—Juss.

A natural family of dicotyledonous plants, placed by some among the apetalous, and by others among the monopetalous. They are herbaceous or suffrutescent vegetables with alternate leaves, which are sometimes all united at the base of the stem, and sheathing. The flowers are disposed in spikes or in branched and terminal racemes. Their calyx is monosepalous, tubular, folded, and persistent, usually of five divisions. The corolla is sometimes monopetalous, sometimes formed of five equal petals, which are often slightly united at their base. The stamina, five in number, and opposite to the divisions of the corolla, are epipetalous when the latter is polypetalous, and immediately hypogynous when the corolla is monopetalous, (which is the contrary of the general arrangement.) The ovary is free, very often of five angles, with a single cell containing an ovule pendent at the top of a filiform and basilar podosperm. The styles, from three to five in number, are terminated by as many awl-shaped stigmas. The fruit is an achenium enve-

loped by the calyx. The seed, besides its proper integument, is composed of a farinaceous albumen, in the centre of which is an embryo, which has the same direction with the seed.

This little family is composed of the genera plumbago, statice, limonium, vogelia of Lamarck, theta of Loureiro, agialitis of R. Brown. It differs from the nyctagineæ, which are monoperianthous by its ovule borne upon a long podosperm at the top of which it is pendent, by many styles and many stigmas, by a straight embryo not curved on itself, &c.

Translator's Note.—Plumbago Europæa grows wild in the South of France. Its root is intensely acrid, particularly when fresh, and has been, therefore, used as a masticatory for the cure of the tooth-ache. It is chiefly used, however, as a cure for the itch, in the form of an ointment, made by boiling two or three ounces of the leaves and root in a pound of olive oil.

FIFTY-SECOND FAMILY.

Primulaceæ, Vent. Lysimachiæ.—Juss.

The primulaceæ are annual or perennial plants, with opposite or verticillated leaves, very rarely scattered. Their flowers are disposed in spikes or in axillary or terminal racemes. Sometimes they are solitary or variously grouped. The monosepalous calyx is of five or four divisions; the corolla monopetalous, regular, is sometimes tubular at its base, sometimes divided very deeply into five segments. The stamina, five in number, are

free or monadelphous, inserted at the top of the tube of the corolla or at the base of its divisions. They are opposite to those divisions, and their introrse anthers open each by a longitudinal groove. The ovary is freeand one-celled, containing agreat number of ovules attached to a central placenta. The fruit is a one-celled and many-seeded capsule, opening by three or five valves, or a pyxidium with a lid. The seeds have a cylindrical embryo placed transversely at the hilum in a fleshy albumen.

The principal genera which compose this family are primula, lysimachia, hottonia, anagallis, cyclamen, centunculus, &c.—Samolus has been also added, although its ovary, to a great extent, adheres to the calyx; but in all its other character sit agrees with this family.

The primulaceæ are very well characterized by their stamina opposite to the divisions of the corolla, their one-celled capsule, whose seeds are attached to a central placenta, and by their embryo placed transversely before the hilum. By these different characters they approach very nearly to the myrsineæ, which differ from them only by their fleshy fruit, and by their seeds imbedded in cells of the placenta, which is very large and fleshy.

FIFTY-THIRD FAMILY.

Lentibulariæ.—Rich.

A small family composed exclusively of the two genera, utricularia and pinguicula, formerly placed in connexion with the primulaceæ. They

are small plants living in the midst of water, or in humid and inundated places. Their leaves are either united in rosaceous clusters at the base of the stems, or divided into capillary and often vesicular segments in the species which float on the surface of the water. Their stem is always simple, bearing one or more flowers at its extremity. Their calyx is monosepalous, persistent, divided as if into two lips. The corolla is monopetalous, irregular, spurred, also two lipped. The stamina, which are two in number, are concealed within the corolla and inserted at its base. The ovary is one-celled, containing a great number of ovules attached to a central trophosperm. The style is simple and very short; the stigma composed of two lamellæ. The fruit is a one-celled, many-seeded capsule, opening either transversely or by a longitudinal cleft, which divides its summit into two valves. The seeds have an embryo immediately covered by the proper integument.

This little family is distinguished from the primulaceæ by its irregular corolla, its two stamina and its embryo without albumen; from the antirrhineæ by its one-celled capsule, whose trophosperm is central, and by its embryo without albumen.

FIFTY FOURTH FAMILY.

Globulariæ.—D. C.

The genus globularia, formerly placed among the primulaceæ, alone constitutes this little family,

of which the following are the principal characters. The calyx is monosepalous, tubular, persistent, of five divisions; the corolla is monopetalous, irregular, tubular, of five narrow, unequal segments of the form of two lips. The stamina, from four to five in number, are alternate with the divisions of the corolla. The ovary is one-celled, containing a single pendent ovule. The style is slender and terminated by a stigma of two tubular, unequal divisions. At the base of the ovary is a small unilateral disc. The fruit is an achenium covered by the calyx. The embryo almost cylindrical, axile, and placed in a fleshy albumen.

The globulariæ are herbaceous or suffrutescent plants, with leaves all radical or alternate, and with small violet flowers, united into a globular capitule, and accompanied with bracteas. They differ from the primulaceæ by their irregular corolla, their alternate stamina, their ovary containing a single reversed ovule.

Translator's Note.—Globularia alypum grows in the south of France. It is a small shrub, whose leaves are accounted by some an excellent substitute for those of senna, and are given in drachm or half ounce doses, boiled in half a pint of water.

FIFTY-FIFTH FAMILY.

Orobancheæ. Vent.

These vegetables are sometimes parasitical on the roots of other vegetables, sometimes terrestrial.

Their stem is sometimes destitute of leaves, which are replaced by scales. Their flowers, accompanied by bracteas, are terminal, sometimes solitary, sometimes disposed in spikes. The calyx is monosepalous, tubular, or divided to the base into distinct sepals. The corolla is monopetalous, irregular, often two lipped. The stamina are in general didynamous. The ovary, applied to an hypogynous, annular disc, has but one cell, containing a great number of ovules attached to two parietal trophosperms, which are bifid at their free side. The style is terminated by a stigma of two unequal lobes. The fruit is a one-celled capsule, opening by two valves, each of which bears a placenta on the middle of its inner surface. The seeds, whose proper integument is double, present a fleshy albumen, which has a very small embryo, placed in a cavity on its upper and lateral part.

The genera orobanche, phelippea, lathræa, &c., form this family, which differs from the scrophularineæ by its one-celled ovary, the position of its embryo, and above all by the port of the vegetables which compose it.

FIFTY-SIXTH FAMILY.

Scrophularineæ.—R. Brown. *Scrophulariæ and Pediculares.*—Juss.

Herbs or shrubs with leaves usually opposite, sometimes alternate, simple, and with flowers dis-

posed in spikes or in terminal racemes. Their calyx is monosepalous, persistent, of four or five unequal divisions; the corolla monopetalous, irregular, two-lipped, and often personate. The stamina, from two to four in number, are didynamous. The ovary applied to an hypogynous disc is two-celled, many-seeded. The style is simple, terminated by a two lobed stigma. The fruit is a two-celled capsule, whose mode of dehiscence is very variable. Sometimes it opens by pores near the top, sometimes by irregular plates, sometimes by two or four valves, bearing each one-half of the dissepiment on the middle of its inner surface, or being opposite to the dissepiment which is entire. The seeds contain under their proper integument a nucleus composed of a fleshy albumen, which contains a straight cylindrical embryo, having its radicle turned towards the hilum, or being opposite to that point of attachment.

We have followed the example of R. Brown, who has united in one the two families established by Jussieu under the name of scrophulariæ and pediculares. The chief difference which served to distinguish those two families, was taken from the mode of dehiscence of the capsule, which in the scrophulariæ is by pores or by valves opposite to the partition which remains entire, whereas in the pediculares each valve bears on the middle of its inner surface one-half of the dissepiment. But these differences, which appear so striking, present numerous shades, and in the genus veronica, for instance, we find

them all united. But we have observed another difference between these two groups, which, however, we have not as yet examined in all their genera, but which appears to us to be constant in all those whose seeds we have examined; namely, that in the pediculares of Jussieu the embryo has always a direction opposite to that of the seed, that is, its cotyledons are turned towards the hilum, while the contrary takes place in the scrophulariæ.

1st. The pediculares: pedicularis, rhinanthus, melampyrum, veronica, euphrasia, erinus, &c.

2d. Scrophulariæ: antirhinum, linaria, scrophularia, digitalis, gratiola, &c.

Translator's Note.—The plants contained in this family are not very uniform in their properties. Most of them however contain an acrid principle, which in the hedge hyssop (gratiola officinalis) is purgative, as well as in the different species of scrophularia. Large doses of fox-glove act so violently in the same way, as to be absolutely poisonous. Eyebright (euphrasia officinalis) is slightly astringent and aromatic, and hence its efficacy in collyria.

FIFTY-SEVENTH FAMILY.

Solaneæ.—Jussieu.

In this family are found herbaceous plants, shrubs, and even small trees of considerable stature, sometimes furnished with prickles on many of their parts, having simple or divided leaves, alternate or sometimes twin upon the upper part of the branches. The flowers, sometimes very large, are either extra-axillary, or form spikes or

racemes. Their calyx, monosepalous and persistent, has five divisions of little depth; their corolla, monopetalous, regular in the greater number of cases, presents various forms, and has five lobes of greater or less depth, which are folded upon one another. The stamina, of the same number with the lobes of the corolla, have their filaments free, rarely monadelphous at their base. The ovary, placed upon an hypogynous disc, is usually of two, rarely of three or four many-seeded cells, whose ovules are attached to the inner angle. The style is simple, terminated by a two-lobed stigma. The fruit is either a capsule of two or four many-seeded cells, opening by two or four valves, or a berry, which is also of two or three cells. The seeds, sometimes reniform and with a wrinkled episperm, contain a more or less curved embryo in a fleshy albumen.

The solaneæ have the closest affinity to the scrophularineæ. They differ from them by their leaves always alternate, their corolla regular, their stamina of the same number with the lobes of the corolla, and above all by their embryo curved upon itself. The latter character is sometimes even the only one which really distinguishes the solaneæ with an irregular corolla from certain scrophularineæ. Theg enera belonging to this family form two sections according to the nature of their fruit.

1st. The fruit capsular: nicotiana, verbascum, hyocyamus, datura, &c.

2d. The fruit fleshy: solanum, atropa, capsicum, physalis, lycium, &c.

Translator's Note.—Most of these plants are acronarcotic; but yet there are some remarkable exceptions. Thus, the radical tubers of the potatoe (solanum tuberosum) and of some other species consist almost exclusively of pure fecula, while the roots of the henbane, the mandrake, and the deadly night-shade, are a more active poison than any other part of those plants. All the species of verbascum are mild and mucilaginous.

The fruits of the egg plant (solanum melongena,) of the love apple (solanum lycopersicum,) of the winter cherry (physalis alkakengi,) and of the capsicum, are either eaten alone, or used as condiments, while those of most of the others are deadly poisons.

The plants belonging to this family differ widely in their chemical composition; it could never, therefore, serve as a guide for discovering the similarity of their effects on the animal economy. Here then, we have an example of plants which possess the same botanical structure agreeing in their medicinàl virtues, even when they differ in the proximate principles that compose them.

FIFTY-EIGHTH FAMILY.

Acanthaceæ.—Juss.

The acanthaceæ are herbs or small trees with opposite leaves, and flowers disposed in spikes and accompanied with bracteas at their base. Their calyx is monosepalous, of four or five divisions, regular or irregular. The corolla is monopetalous, irregular, usually bilabiate. The stamina are two to four in number, didynamous. The ovary has two cells which contain two or a greater

number of ovules. It is applied to an hypogynous, annular disc. The style is simple, terminated by a two-lobed stigma. The fruit is a two-celled capsule, sometimes one-seeded, opening elastically by two valves, each of which carries with it one half of the dissepiment. The seeds are in general borne upon a filiform podosperm, and their embryo placed immediately under their proper integument is destitute of albumen, and has in general its radicle towards the hilum.

Ex: Justicia, Acanthus, Ruellia, Thunbergia, &c. This family differs from the scrophularineæ by its seeds borne upon a long podesperm, by an embryo without albumen, &c.

FIFTY-NINTH FAMILY.

Jasmineæ.—Juss. *Jasmineæ and Lilaceæ.*—Vent. *Oleineæ.*—Link.

This family is composed of shrubs, of small trees, or even of large ones with opposite leaves, rarely alternate, simple or pinnate. The flowers are hermaphrodite, except the genus fraxinus, in which they are polygamous. The calyx is monosepalous, turbinated in its lower part; the corolla is monopetalous, often tubular and irregular, with four or five lobes, sometimes so deep that the corolla appears polypetalous (ornus, chionanthus;) it is sometimes wholly wanting. The stamina are

only two in number. The ovary is of two cells, each containing two suspended ovules. The style is simple, terminated by a two-lobed stigma. The fruit is sometimes a capsule of one or two cells, indehiscent, or opening by two valves; sometimes it is fleshy and contains a bony nut. The proper integument of the seed is thin or fleshy. The albumen is fleshy or hard. It contains an embryo having the same direction with the seed.

The genera of this family, which had been divided into three distinct orders, but which ought to remain united, as we have shewn (Mem. Soc. Nat. Hist. Paris, tom. 2d) may be divided into two sections in the following manner:—

1st. The fruit dry, lilaceæ: lilas, fontanesia, fraxinus, nyctanthes.

2d. Fruit fleshy, jasmineæ: jasminum, olea, ligustrum, phillyrea, &c.

Translator's Note.—The olive oil is obtained by pressure from the pulp of the olive. In general, the fixed oils of vegetables reside in their seeds, from which they may be seperated by boiling or pressure. The fruits of the olive tree and of the bead tree (melia,) in which the fixed oil resides in the pericarp, are the only known examples of a deviation from this general law.

The leaves of the olea fragrans are used by the Chinese to to communicate a perfume to teas.

The bark of the lilach has been employed successfully as a cure for intermittents.

Several species of the fraxinus are capable of yielding manna; but that of the ornus is more esteemed than any other.

SIXTIETH FAMILY.

Verbenaceæ.—Juss.

The verbenaceæ are either trees or shrubs, rarely herbaceous plants, with leaves usually opposite, sometimes compound. The flowers are disposed in spikes or in corymbs, more rarely they are axillary or solitary. Their calyx is monosepalous, persistent, tubular. The corolla is monopetalous, tubular, usually irregular. The stamina are didynamous, sometimes only two. The ovary is of two to four cells, containing one or two erect ovules. The style is terminated by a simple or bifid stigma. The fruit is a berry or a drupe containing a nut of two or four cells, often one-seeded. Besides the proper integument, the seed consists of a thin and fleshy albumen which covers a straight embryo.

This family, composed of the genera verbena, vitex, clerodendron, zapania, &c. is distinguished from the former by its fleshy fruit (except verbena,) and by its seeds usually solitary in each cell.

SIXTY-FIRST FAMILY.

Myoporineæ.—R. Brown.

Shrubs generally glabrous, with simple leaves, alternate or opposite, and axillary flowers without bracteas. Their calyx is persistent, of five deep

divisions. Their monopetalous corolla is almost regular or slightly two-lipped. Their stamina are didynamous or sometimes five in number, of which one remains sometimes in the rudimental state. The ovary is free applied to an hypogynous, annular disc. It is of two or four cells, containing each one or two ovules, pendent from their top. The simple style is terminated by an equally simple stigma. The fruit is a drupe containing a nut of two or four cells, each enclosing one or two seeds, composed of a cylindrical embryo, placed in the centre of a pretty dense albumen.

The myoporineæ, being allied to the verbenaceæ, from which they differ particularly by their pendent seeds, furnished with a thick albumen, are composed of the genera myoporum, bontia, pholidia, stenochilus, eromophila.

SIXTY-SECOND FAMILY.

Labiatæ.—Juss.

The Labiatæ form one of the most natural families of the vegetable kingdom. They are herbaceous plants, or sometimes shrubs, whose stem is square, leaves simple and opposite, flowers grouped in the axillæ of the leaves, and forming thus by their union either spikes or branched racemes. Their calyx is monosepalous, tubular, of five unequal teeth. Their corolla, monopetalous, tubular and irregular, is divided into two lips, one

upper, the other lower. The number of stamina is four, didynamous. Sometimes the two shorter prove abortive. The ovary, applied to an hypogynous disc, is deeply four-lobed, much depressed in the centre, from which arises a simple style, surmounted by a bifid stigma. A transverse section of the ovary exhibits four cells, containing each an erect ovule. The fruit is composed of four one-seeded acheniums, contained within the calyx, which is persistent. The seed contains an erect embryo in the centre of a fleshy, sometimes very thin albumen.

The very numerous genera of this family may be divided into two sections accordingly as they have two or four didynamous stamina.

§ 1st. Two stamina. Salvia, rosmarinus, monarda, lycopus, &c.

§ 2nd. Four didynamous stamina. Betonica, lavandula, mentha, leonurus, thymus, ballota, phlomis, satureia, &c.

Translator's Note.—The plants of this family contain essential oil, camphor, and bitter extractive. Some deny the existence of camphor in these vegetables, on the ground that the substance which has received that name cannot be converted by the action of nitric into camphoric acid. They may be used as aromatic stimulants when the essential oil and camphor predominate, and as tonics, when there is a greater proportion of bitter extractive.

SIXTY-THIRD FAMILY.

Boragineæ.—Juss.

The borgineæ are herbs, shrubs, or sometimes even tall trees, bearing alternate leaves, which are often covered, as well as the stem, with very rough hairs. Their flowers form unilateral spikes, circinnate at the top, often united and forming a sort of panicle. Their calyx is monosepalous, regular, persistent, and five lobed; the corolla is monopetalous, regular, five lobed. In a certain number of genera, it presents at its throat five projecting appendages, which are hollow within, and which open externally at their base. The five stamina are inserted at the top of the tube of the coralla, and alternate with the appendages of which we have now spoken, when these are present. The ovary borne upon an hypogynous, annular, waving disc, is deeply four-lobed, with four one-seeded cells, greatly depressed in the centre. The style arises from this depression, and terminates in a two-lobed stigma. The fruit consists of four one-seeded carpels; more rarely they are united, and form a dry or fleshy fruit of two or four cells, sometimes bony, or a fruit which is one-celled by abortion. The seeds have their embryo reversed in a fleshy albumen, which is very thin, and sometimes even wholly wanting.

The family of the Boragineæ has a close affinity to the la-

biatæ in the structure of its pistil, which is the same, and also to the scrophularineæ. But it is distinguished from the former by its cylindrical stem, its alternate leaves, its regular corolla, its stamina, which are five in number, &c. from the latter by the structure of its ovary and of its fruit.

We shall cite as examples of the genera of this family the following:—

§ 1st. Genera without an appendage to the corolla. Echium, lithospermum, pulmonaria, onosma, cordia, &c.

§ 2nd. Genera furnished with appendages: symphitum, lycopsis, anchusa, borago, cynoglossum, &c.

Vent. had proposed to separate from the boragineæ the genus cordia on account of its simple and fleshy fruit, and to make of it a family under the name of Sebesteniæ. Mr. R. Brown (Prodr. fl. Rob. Holl.) thinks that the genera hydrophyllum, ellisia and phacelia, which have a capsular fruit, a large, horny albumen, and compound or deeply lobed leaves, form a distinct family, which he calls hydrophylleæ. And lastly, Professor Schader, in his excellent Memoir on the Boragineæ, proposes to divide them into three distinct orders, namely: the boragineæ, the hydrophylleæ, and the heliotropiæ. But the differences which exist between these three groups appear to us be too trivial to justify their separation into distinct families.

Translator's Note.—These plants contain a large quantity of mucilage with some astringency. Cynoglossum contains a bitter principle, which is slightly narcotic. The root of the anchusa tinctoria is used for its colouring matter, and the borage is said to be diuretic, as containing a small quantity of nitrate of pot-ash.

SIXTY-FOURTH FAMILY.

Convolvulaceæ.—Juss.

Herbaceous or suffrutescent plants, often twining and climbing, having alternate, simple

leaves, or more or less deeply lobed; flowers either axillary or terminal; calyx monosepalous, persistent, of five divisions; corolla monopetalous, regular, also of five plaited lobes; five stamina inserted in the tube of the corolla. The ovary is simple and free, borne upon an hypogynous disc. It presents from two to four cells containing a small number of ovules. The style is simple or double. The fruit is a capsule with cells varying from one to four, containing usually one or two seeds, attached towards the base of the partitions. It opens by two or four valves, whose edges are applied to the partitions, which remain in their situation. More rarely the capsule is closed, or opens by two valves placed the one above the other. The embryo, whose cotyledons are flat and plicate, is rolled round itself, and placed in the centre of a soft, and as it were mucilaginous albumen.

The essential character of this family consists in its capsule, whose sutures correspond with the partitions. This character being wanting in some genera formerly united to the convolvulaceæ, such as hydrolea, nama, sagonea and diapensa, Mr. R. Brown has proposed to form them into a distinct family under the name of hydroleaceæ. The principal genera of the convolvulaceæ are, convolvulus, ipomæa, cuscuta, evolvulus, cressa, &c.

Translator's Note.—All the convolvuli, with a few exceptions, are acrid and purgative. The roots of the indigenous species of convolvulus, as well as of those which produce scam-

mony and jalap, possess the purgative quality, but only in a slight degree. From fifteen to twenty grains of the watery extract of the roots of c. sepium act freely as a drastic purgative, and without much griping. Haller used the expressed juice of the herb for the same purposes as scammony.

The roots of the c. batatas (Spanish potatoes,) and of the c. edulis, consist almost exclusively of amylaceous fecula. The former is cultivated in all the tropical climates, nearly in the same manner as our potato, and its roots, together with its leaves and young shoots, are reckoned a wholesome and nutritious food.

SIXTY-FIFTH FAMILY.

Polemoniaceæ.—Juss.

Herbaceous or woody plants, sometimes twining, furnished with alternate or opposite leaves, often divided and pinnatifid, and with axillary or terminal flowers, forming branched racemes. Each flower is composed of a monosepalous calyx, of five lobes; of a monopetalous, regular corolla, rarely irregular, with five divisions more or less deep; of five stamina inserted in the corolla; of an ovary applied to a disc often expanded and lobed at the bottom of the flower. This ovary presents three cells containing one or oftener several ovules. The style is simple, terminated by a trifid stigma. The fruit is a capsule of three cells, opening by three valves, septiferous on the middle of their inner surface, or bearing only the mark of the partition, which remains entire in the

middle of the capsule. The seeds have an erect embryo in the centre of a fleshy albumen.

This family stands between the convolvulaceæ and bignoniaceæ. It differs from the former by its valves bearing dissepiments on the middle of their surface, and not contiguous by their edges to those partitions, and by its erect embryo; from the latter by its corolla, almost always regular, its ovary three-celled, its valves bearing dissepiments, &c. The genera which compose this family are few in number, such as, Polemonium, Phlox, Cantua, Bonplandia, and probably Cobæa.

SIXTY-SIXTH FAMILY.

Bignoniaceæ. – Juss. *Bignoniaceæ and Pedalineæ.*—R. Brown.

They are trees, shrubs, or more rarely herbaceous plants, whose stem is often sarmentaceous and furnished with tendrils. Their leaves, usually opposite or ternate, are rarely alternate, generally compound. Their flowers, which are terminal or axillary, variously grouped, have a monosepalous calyx, often persistent and five-lobed; a monopetalous corolla, more or less irregular, and of five divisions. In general there are four didynamous stamina, accompanied with a barren filament, which is the rudiment of a fifth abortive stamen. In some genera the five stamina are equal, or two only are fertile. The ovary, borne upon an hypogynous disc, presents one or two cells, containing

usually several ovules. The simple style is terminated by a stigma of two lamellæ. The fruit is a capsule of one to two cells, opening by two valves opposite to the partition. Rarely the fruit is fleshy, or hard and indehiscent. The seeds, often bordered by a membranous wing on their whole circumference, contain under their proper integument an erect embryo without albumen.

The principal genera of this family are, bignonia, catalpa, jacaranda, tecoma, &c., whose seeds are winged, and sesamum, martynia, craniolaria, whose seeds have no wings, and constitute the tribe sesameæ of Kunth. As to the genera pedalium and josephinia, of which Mr. Brown has made a distinct family, under the name of Pedalineæ, we think they have too many points of agreement with the sesameæ to be separated from them.

SIXTY-SEVENTH FAMILY.

Gentianeæ.—Juss.

Almost all the gentianeæ are herbaceous vegetables, rarely frutescent, bearing opposite, entire glabrous leaves; solitary flowers, either terminal or axillary, or united in simple spikes. Their monosepalous calyx, often persistent, has five divisions. The monopetalous corolla is regular, usually composed of five lobes, which are imbricated before expansion. The stamina, of the same number with the divisions of the corolla, are alternate with them. The ovary, sometimes contracted at its base and fusiform, has a single

cell, containing a great number of ovules attached to two sutural and parietal trophosperms, bifid on the inside. The style is simple, or deeply bipartite; each division bears a stigma. The fruit is a one-celled capsule, containing a great number of seeds. It opens by two valves, whose edges are more or less inflected to meet the placentas. The seeds are in general very small, and their embryo, which is erect, is contained in the axis of a fleshy albumen.

This family is well characterised by its port, its opposite entire leaves of a glaucous green colour. It is related on the one hand to the polemoniaceæ, from which it differs by its opposite leaves, its ovaries of one cell only, and by the peculiar dehiscence of its capsule; on the other, to the scrophularineæ; but the latter, by their irregular corolla, their four didynamous stamina, and the dehiscence of their fruit, are easily distinguished from it. We shall cite among other genera of the gentianeæ, gentiana, erythræa, chironia, exacum, villarsia, menyanthes. The two latter are remarkable for their alternate leaves, which are ternate in menyanthes.

Translator's Note.—The plants belonging to this fafamily are intensely bitter. The g. lutea grows wild in the south of Europe, and is more extensively employed than the other species. The root of g. purpurea is very thick and bitter, but the species is less abundant than the lutea; it is, therefore, but little used. The tops of the erythræa centaurium, which is indigenous in Britain, have long sustained their reputation as an useful tonic. The g. chirayita, which is a native of the East Indies, has been lately introduced as a certain febrifuge, and an useful tonic. Menyanthes trifoliata is justly

esteemed a powerful bitter. Its dose is from one to three ounces of the expressed juice of the stem and leaves; or it may be given in the form of decoction or of extract.

SIXTY-EIGHTH FAMILY.

Apocyneæ.—Juss. *Apocyneæ, Asclepiadeæ.*— R. Brown. *Strychneæ.*—Juss.

The apocyneæ present a very varied aspect. They are herbaceous plants, shrubs, or even tall trees, usually lactescent. Their leaves are simple and opposite, entire; their flowers are axillary or terminal, solitary or variously united. In each there is a monosepalous calyx, of five divisions, sometimes spreading, sometimes tubular; a monopetalous, regular corolla of various forms, having sometimes five petaloid appendages, which are concave, grow from the throat of the corolla, and are partly united with the stamina. The latter, being five in number, are sometimes free and distinct, sometimes united by their filaments and anthers, and form a kind of tube which covers the pistil, and is often united at the top to the stigma. The anthers are two-celled, and the pollen which they contain is powdery in those whose stamina are free, and in solid masses of the same form with the inside of the cell, in those whose stamina are united. Each mass of pollen is terminated at the top by a gland which is united to

that of the mass at whose side it is placed. Two free ovaries, applied to an hypogynous disc, united by their inside or only by their top, present each a cell, which contains a great number of ovules placed at its inner suture. The two styles are sometimes united into one, and terminate in a stigma, which is more or less discoid, sometimes cylindrical and truncated. The fruit is a simple or double follicle; more rarely it is fleshy and indehiscent. The seeds attached to a sutural trophosperm are naked or crowned by a pappus. They contain a straight embryo in a fleshy or horny albumen.

This family is divided into two by Mr. R. Brown, namely:

1st. The true apocyneæ, which have the corolla without appendages, and the pollen powdery; such are the genera apocynum, vinca, rauwolfia, arduinia, nerium, &c.

2d. The asclepiadeæ, whose corolla is furnished with appendages, and whose pollen is in solid masses, like that of the orchideæ. Such are the genera asclepias, hoya, cynanchum, &c.

Translator's Note.—The plants of this family abound with a milky, poisonous juice. The seeds of the strychnos nux vomica, and of the s. ignatia contain strychnia and brucia in combination with igasuric acid. The upas tieuté, with which the Japanese poison their arrows, is prepared from a species of the same genus, and contains the same alkalis. The root of the periploca secamone yields the Smyrna scammony, and that of the cynanchum monspeliacum the scammony of Montpelier. The leaves of the c. oleæfolium are a powerful purgative, and are therefore employed to adulterate the leaves of the Ægyptian senna.

SIXTY-NINTH FAMILY.

Sapoteæ.—Juss.

Trees or shrubs all exotic and growing for the most part within the tropics. Their leaves are alternate, very entire, persistent, coriaceous; their flowers hermaphrodite and axillary. They have a persistent, monosepalous calyx, a monopetalous, regular corolla, the number of whose lobes is equal to, double or triple those of the calyx. The stamina are definite in number. Some are fertile, of the same number with the lobes of the calyx, and opposite to the petals; others barren, and alternate with the former. The ovary is many-celled, containing each an erect ovule. The style is in general terminated by a simple stigma, which is sometimes lobed. The fruit is fleshy, of one or more one-seeded cells, which are sometimes bony. The embryo is erect, contained in a fleshy albumen, which is rarely wanting.

The genera of this family are achras, mimusops, syderoxylon, imbricaria, lucuma, &c. It has close affinities to the ebenaceæ, which differ from it by their flowers usually unisexual, their stamina placed in two rows, their style divided, and their seeds pendent.

Translator's Note.—The plants of this family agree with those of the apocyneæ in containing a large quantity of a milky juice, which, however, is very mild and nutritious.

Their seeds contains a fixed oil of the consistence of butter. The achras mamosa bears a fruit whose pulp resembles marmalade. The fruit of the naseberry tree (achras zapotilla,) contains, when first gathered, a white and clammy juice, which, in a few days, becomes perfectly clear and sweet. The palo de vacca or cow tree, which is regularly milked by the inhabitants of South America, is supposed to belong to the same family.

SEVENTIETH FAMILY.

Myrsineæ—R. Brown. *Ardisiaceæ.*—Juss. *Ophiosperma.*—Vent.

The myrsineæ are trees or shrubs with alternate leaves, very rarely opposite or ternate, glabrous, coriaceous, entire or toothed, without stipules; with flowers disposed in racemes or in a kind of umbel, or simply grouped either in the axillæ of the leaves or at the tops of the branches. The flowers are hermaphrodite, rarely unisexual; their calyx, generally persistent, has four or five deep divisions; their corolla is monopetalous, regular, of four or five lobes; the stamina of the same number with the lobes of the corolla, sometimes monadelphous, are attached to the bases of the lobes, and are opposite to them. The filaments are short, the anthers sagittate. The ovary is free, one celled, containing a variable number of ovules, inserted on a central placenta, in which they are sometimes more or less deeply imbedded. The style is simple, terminated by a simple or

lobed stigma. The fruit is a kind of dry drupe, or a berry, containing from one to four seeds. The seeds are peltate, having their hilum concave; their simple integument covers a fleshy or horny albumen, in which is placed a cylindrical, somewhat curved embryo, placed transversely at the hilum.

This family is closely allied to the sapoteæ and the ebenaceæ in its port and in many of its characters. On the other hand, the structure of its ovary and its stamina opposite to the lobes of the corolla connect it with the primulaceæ. The genera which compose the family of the myrsineæ are the following: myrsine, ardisia, jacquinia, samara, wallenia, and ægicera.

SEVENTY-FIRST FAMILY.

Ebenaceæ.—Rich. *Guayacaneæ.*—Juss.

This family is composed of trees or shrubs not lactescent, whose wood is very hard and often of a dark colour in its centre. The leaves are entire, often coriaceous, alternate, and shining. Their flowers are in general axillary, rarely hermaphrodite, most usually polygamous. Their calyx is monosepalous, of three or six equal, persistent divisions. The corolla is monopetalous, regular. Its limb is of three or six imbricated divisions. The stamina are of a definite number, sometimes inserted in the corolla, sometimes immediately hy-

pogynous. Their number is double or quadruple the divisions of the corolla, very rarely equal, and in that case alternate with them. In general the stamina are disposed in two rows, and have their anthers linear, lanceolate and two-celled. The ovary is free, sessile, many-celled, containing each one or two pendent ovules. The style is divided, more rarely simple; the stigmas are simple or bifid. The fruit is a globular berry, opening sometimes almost regularly, and containing a small number of compressed seeds. The integument of the latter contains a cartilaginous albumen, in which is an embryo, that has the same direction with the seed.

My father has taken from the family of the guayacaneæ of M. De Jussieu a certain number of genera which differ from them considerably, and of which he has formed the family of the styraceæ. As it is at present limited by modern botanists, the family of the ebenaceæ is composed of the genera diospyros, royena, paralea, &c. It is related to the sapoteæ; but the latter have their stamina of the same number with the divisions of the corolla, to which they are opposite, and moreover present many other distinctive characters. As to the styraceæ, we shall point out, after the description of that family, the characters by which it is distinguished from the ebenaceæ.

NINTH CLASS.

PERICOROLLY.

SEVENTY-SECOND FAMILY.

Styraceæ.—Rich. *Symploceæ.*—Juss.

This little family contains trees or shrubs with alternate leaves without stipules; with flowers axillary, sometimes terminal. The calyx is free or adheres to the inferior ovary; the limb is entire or divided. The corolla is monopetalous regular. The stamina, whose number varies from six to sixteen, are free or monadelphous at their base. The ovary, as we have already stated, is sometimes superior, sometimes inferior, usually of four cells, separated by very thin membranous dissepiments. Each of these cells contains usually four ovules, attached to the inner angle of the cell, two of which are erect and two reversed. The style is simple, terminated by a very small and simple stigma. The fruit is slightly fleshy. It contains from one to four bony nucules, which are more or less irregular. Besides its proper integument, the seed consists of a fleshy albumen, which contains a cylindrical embryo, having the same direction with the seed.

This family is composed of the genera halesia, symplocos,

styrax, alstonia, cyponima, which formerly constituted a part of the family of the ebenaceæ. My father has removed them from it, and formed of them the new family styraceæ, which differs from the former by its perigynous insertion, its ovary whose seeds contain four ovules, of which two are erect and two reversed, and by its simple style.

Translator's Note.—The styrax officinale yields storax, from incisions made in its bark. For this purpose it is cultivated in Asiatic Turkey. By wounding the bark near the lower branches, the gum benzoin is obtained from the s. benzoin, a tree of considerable altitude, which grows in Java, Sumatra, and other parts of the east.

SEVENTY-THIRD FAMILY.

Ericineæ, Ericæ and Rhodora—Juss. *Epacrideæ.* R. Brown. *Vaccinieæ.*—Desv.

Shrubs or small trees of an elegant port, having in general simple alternate leaves, rarely opposite, verticillated or very small, in the form of imbricated scales. Their inflorescence is very variable. The monosepalous calyx is sometimes free, sometimes adheres to the ovary, which is then inferior ; of five divisions, sometimes so deep as to appear to be formed of five distinct sepals. The corolla is monopetalous, regular, of four or five lobes, sometimes of four or five distinct petals. The stamina, whose number is in general double the divisions of the corolla, have their filaments free, rarely united at their base. Their

anthers are introrse, of one or two cells, sometimes terminated by two appendages in the shape of horns at their summit and base, and opening in general by a pore near the summit. These stamina are generally attached to the corolla ; but sometimes they are immediately hypogynous. The ovary is inferior or free. In the latter case it is sessile at the bottom of the flower, or applied to an hypogynous disc, more or less prominent, and sometimes in the shape of lobes or scales. It presents from three to five cells containing each a considerable number of ovules, attached to its inner angle. The style is simple, terminated by a stigma having as many lobes as there are cells in the ovary. The fruit is a berry, or more usually a capsule, sometimes crowned by the limb of the calyx, and opening by as many valves as there are cells. Sometimes each of the valves carries with it one of the partitions on the middle of its inner surface (loculicidal dehiscence.) Sometimes the dehiscence takes place opposite to each partition, (septicidal dehiscence.) The seeds consist of a fleshy albumen, in the midst of which is an axile, cylindrical embryo, having the same direction with the seed.

In this family we include the rhodoraceæ of M. De Jussieu, which differ from the ericineæ only in their capsule, whose valves carry away the partitions on the middle of their inner surface, while in the ericineæ, the dehiscence takes place in

general opposite to the dissepiments. But both modes of dehiscence may be observed in several genera of the ericineæ. As to the epacrideæ of Mr. Brown, there is no other essential difference between this group and the ericineæ, than that their anthers are always one-celled, and that they have a different port. We think it right to add them to this family, and to make them only a section of it. We shall divide the ericineæ in the following manner:—

1st. Vaccineæ, genera with an inferior ovary. Vaccinium, escalonia, gaylussaccia, &c.

2d. Ericineæ. Ovary free, disc hypogynous, anthers two-celled: erica, rhododendron, rhodora, ledum, clethra, arbutus, andromeda, &c.

3d. Epacrideæ. Ovary free, disc in the form of five hypogynous scales, anthers one-celled. Epacris, styphelia, leucopogon, &c.

Translator's Note.—The uva ursi and pyrola umbellata are astringent, and useful in diseases of the kidneys and of the bladder. The rhododendron is acrid and poisonous, and in Russia is accounted a specific for rheumatism, syphilis, and skin diseases. The fruits of the bilberry and cranberry are acidulous, and, therefore, are sometimes employed in the preparation of cooling drinks.

SEVENTY-FOURTH FAMILY.

Gesneriaceæ.—Rich.

These are herbaceous plants, rarely suffrutescent at their base, bearing opposite or alternate leaves, and axillary or terminal flowers. The calyx is monosepalous, persistent, of five divisions,

adhering by its base to the ovary, which is generally inferior. The corolla is monopetalous irregular, of five unequal lobes, sometimes forming as it were two lips. There are two or four stamina inserted in the corolla. The ovary, as we have said, is either inferior or free. In the first case it is crowned by an epigynous disc, which is often lobed. In the second, the disc is hypogynous and often lateral. The style is very simple, terminated by a stigma which is simple and concave in its centre. The ovary presents a single cell, in which a very considerable number of ovules is attached to two parietal trophosperms, which are branched towards the cell. The fruit is either fleshy or dry, and forms a one-celled capsule, which opens by two valves.

The following genera are cited as belonging to this family, gesneria, gloxinia, besleria, columnea, achimenes. But if we except the two first, which have an inferior ovary, the other three, to which may be added ramondia, formerly placed in the solanaceæ, appear to us to differ in no respect from the orobancheæ. Perhaps it would be proper to reduce the gesneriaceæ to those genera only which have an inferior ovary.

SEVENTY-FIFTH FAMILY.

Campanulaceæ.—Juss.

The campanulaceæ are in general herbaceous or suffrutescent plants, usually filled with a white and bitter juice. Their leaves are alternate and

entire, rarely opposite. Their flowers form spikes or thyrses, or are collected in capitules. They have a monosepalous calyx, of four, five, or eight persistent divisions; a monopetalous regular or irregular corolla, having its limb divided into as many lobes as there are divisions in the calyx, sometimes as if two-lipped. The five stamina are alternate with the lobes of the corolla. Their anthers are free or united in the form of a tube. The ovary is inferior or half inferior, of two or more many-seeded cells. The style is simple, terminated by a lobed stigma, sometimes surrounded by hairs, or by a sort of cup-shaped cavity. The fruit is a capsule crowned by the limb of the calyx, of two or of a greater number of cells, opening either by the means of pores formed towards the upper part, or by incomplete valves, which carry with them a part of the partitions on the middle of their inner surface. The seeds, very small and very numerous, contain in a fleshy albumen, an axile, erect embryo.

We here unite the families of the campanulaceæ, of the lobeliaceæ, of the goodenovieæ and of the stylideæ, which have common characters too closely resembling each other to be formed into so many distinct families. We shall consider them only as tribes of the same natural order.

1st. Campanulaceæ. Corolla regular, stamina distinct, capsule two-celled, many-seeded. Ex. campanula, phyteuma, prismatocarpus, jasione, &c.

2nd. Lobeliaceæ, Rich. Corolla irregular, stamina united by

their anthers, stigma surrounded by hairs. Ex. Lobelia, lysipomia, &c.

3rd. Goodenovieæ, R. Brown. Corolla irregular, stamina free or united by their anthers. Stigma surrounded by a kind of cup-shaped cavity, capsule bilocular, or a one-seeded nut.

Ex. Goodenovia, euthales, lechenaultia, &c.

Stylidieæ, R. Brown. Corolla irregular, two stamina whose filaments are united and confounded with the style, and form a kind of central column. Stigma situated between the two anthers; capsule two-celled, two-valved. Ex. Stylidium, Lewenhockia, &c.

Translator's Note.—Almost all the plants of this family are lactescent. Their milky juice is bitter, and sometimes very acrid; but these qualities are often concealed by the presence of a large quantity of mucilage, in which case they may be eaten. Of this we have an example in the C. rapunculus (rampion) whose root is taken up in spring and eaten as a salad. The roots and the young shoots of the phyteuma spicata are employed for the same purpose, but the latter become acrid and bitter as they grow old. This acrimony and bitterness are very remarkable in several species of the lobelia, such as the l. urens, l. tupa, &c. The efficacy of the l. syphilitica in the cure of syphilis and of other skin diseases depends on the presence of the same quality.

TENTH CLASS.

EPICOROLLY—SYNANTHEREÆ.

SEVENTY-SIXTH FAMILY.

Synanthereæ.—Rich. *Cichoraceæ, Corymbiferæ et Cynarocephalæ*—Juss. *Compositæ.*—Auct.

This great family is one of the best characterised and of the best limited of the vegetable king-

dom. It comprises herbaceous plants, shrubs, or even small trees of variable statures. Their leaves are usually alternate, rarely opposite. Their flowers, generally small, form capitules or calathides, either hemisphærical, globular, or more or less oblong. Each capitule is composed, 1stly, of a common receptacle, thick, and sometimes fleshy, convex or concave, which has received the names of phoranthium and clinanthium. 2ndly, Of a common involucre, which surrounds the capitule, and is composed of scales, whose form, number and disposition vary according to the genera. 3rdly, On the receptacle there are often found, at the base of each flower, small scales or hairs, more or less numerous. The flowers which form the capitules are of two kinds. The one present a monopetalous corolla, which is regular, funnel-shaped, and in general of five regular lobes. These are called flosculous. The others have an irregular corolla turned down laterally in the form of a strap. They are called semiflosculous. Sometimes the capitules are composed exclusively of flosculous flowers, (flosculosi,) sometimes only of semiflosculous flowers, (semiflosculosi.) Sometimes, in fine, their centre is occupied by flosculous, and their circumference by semiflosculous flowers, (radiati.) Each flower presents the following organization: The calyx adhering to the ovary has its limb entire, membranous, toothed, formed of scales or of hairs;

the corolla is monopetalous regular or irregular; there are five stamina with distinct filaments, but whose anthers are united and form a tube through which passes a simple style terminating in a bifid stigma. The fruit is an achenium, naked at the top, or crowned by a membranous border, by small scales, or by a simple or feathery pappus, sessile or stipitate. The seed is erect, containing an homotrope embryo without albumen.

This family, which has been the object of a great many important works, may be divided into three tribes in the following manner:

1st. The cynarocephalæ, all whose florets are flosculous, and whose receptacle is covered with numerous hairs or dotted, and whose style is swelled and furnished with hairs under the stigma; such are the genera carthamus, carduus, cynara, centaurea, onopordum, &c.

2nd. The chicoraceæ, all whose flowers are semiflosculous. Such are the genera lactuca, cichorium, sonchus, hieracium, prenanthes, &c.

The corymbiferæ, whose capitules are in general composed of flosculous florets in the centre, and of semiflosculous in the margin. Ex. Helianthus, chrysanthemum, anthemis, matricaria, &c.

Translator's Note.—The plants of this extensive family are stimulant and tonic. They possess these qualities in different degrees, according to the proportions of essential oil and of bitter extractive which may be contained in them. Those which abound with a milky juice are, in some degree, narcotic.

The subdivisions of this family are as distinct in their chemical composition, and in their effects on the animal economy,

as in their botanical characters. Thus, the cinarocephelæ contain chiefly bitter extractive, and are, therefore, tonic. Some of them, which are but slightly bitter, act on the skin and promote the secretion of urine, such as the burdock (arctium lappa.) The blessed thistle (cnicus benedictus,) and the milk thistle (carduus marianus,) are intensely bitter, and are those which have been chiefly employed for their tonic and febrifuge virtues.

The chicoraceæ, which abound with a milky juice, are bitter, and sometimes narcotic. Thus the inspissated juice of the lactuca sativa has been, in some cases, substituted for opium. This property is still more remarkable in the l. virosa, which derives its specific name from its poisonous qualities. Plants of this tribe, which are insupportably bitter in the wild state, are rendered mild, mucilaginous, and fit to be eaten, by cultivation.

The corymbiferæ, besides bitter extractive, contain a large quantity of essential oil. Many of them are, therefore, powerful tonics and aromatic stimulants, such as certain species of anthemis, of tanacetum, of artemisia, &c.

The seeds of the synanthereæ are usually mild, containing a large quantity of fixed oil. To this, however, there are a few exceptions. Thus, the seeds of the artemisia are acrid and employed as a vermifuge; those of the safflower (carthamus tinctorius) are purgative. The pigment called *rouge* is prepared from the flowers of the latter.

SEVENTY-SEVENTH FAMILY.

Calycereæ.—Rich. *Boopideæ.*—Cassini.

These are herbaceous plants, in their port pretty nearly resembling the scabiosæ. Their stem bears alternate leaves, often divided and pinnatifid. The flowers are small, and form globular ca-

pitules, surrounded by a common involucre. The receptacle which bears the flowers is furnished with leafy scales, which are sometimes so united with the flowers as not to be distinguished from them. The calyx adheres to the inferior ovary, and the divisions of its limb are sometimes stiff and spinous. The corolla is monopetalous, regular, tubular, and funnel-shaped. Beneath the five stamina are five nectariferous glands. These stamina are united both by their filaments and anthers, forming a cylindrical tube, and each anther opens by its inner surface. The inferior ovary is of one cell, from the top of which hangs a reversed ovule. The top of the style presents an epigynous disc, and a simple style terminated byan hemisphærical stigma. In the genus acicarpha all the flowers are united together by their ovaries. The fruit is an achenium, crowned by the spinous teeth of the calyx. The seed presents under its proper integument an albumen, in which is contained an embryo reversed like the seed.

This little family is composed of the genera boopis, calycera, acicarpha. It stands between the synanthereæ and dipsaceæ. It differs from the former by its reversed ovule, its stamina united by their anthers and filaments, and by its simple stigma: from the dipsaceæ, by its alternate leaves and united stamina.

ELEVENTH CLASS.

EPICOROLLY—CHORISANTHERY.

SEVENTY-EIGHTH FAMILY.

Dipsaceæ.—D. C. *Dipsacearum, gen.*—Juss.

The stem is herbaceous, the leaves opposite without stipules, the flowers united in hemisphærical or globular capitules, accompanied at their base by an involucre of many leaflets. The calyx is double. The outer is monosepalous, free, entire, or divided into narrow setaceous segments. The inner adheres to the ovary, being terminated by an entire or divided limb. The corolla is monopetalous, tubular, of four or five unequal divisions; the stamina, of the same number with the divisions, are alternate with them.

The ovary is inferior, of one cell, containing a single pendent ovule; the style and stigma are simple. The fruit is an achenium crowned by the calycine limb, and enveloped in the outer calyx. The seed is pendent, and its embryo, which has the same direction with it, is placed in a rather thin albumen.

Professor Decandolle has removed from this family, such as it had been established by Jussieu, the genus valeriana and some others similar to it, in order to form the family valerianeæ, which differs from the true dipsaceæ by its flowers not united in a capitule, by its simple calyx, its lobed stigma, &c.

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In their port, and particularly in their inflorescence, the dipsaceæ have some resemblance to the synanthereæ; but they differ from them by their double calyx, their free anthers, and reversed seeds. The principal genera of this family are dipsacus, scabiosa, Knautia.

SEVENTY-NINTH FAMILY.

Valerianeœ.—D. C.

Herbaceous plants with opposite leaves, simple, or more or less deeply incised; flowers without a calicule, usually disposed in racemes or terminal panicles. Their calyx is simple, adhering to the inferior ovary, having its limb toothed or rolled inwards, and forming an entire edge. The corolla is monopetalous, more or less irregular, being sometimes spurred at its base, and five lobed. The stamina vary from one to five, and are alternate with the lobes of the corolla. The ovary is one-celled (sometimes there are found two other empty cavities or false cells, so that the ovary seems to be three-celled.) This cell contains a single pendent ovule. The style is simple, terminated in general by a trifid stigma. The fruit is an achenium crowned by the teeth of the calyx, or by a feathery pappus, formed by the unfolding of the limb. The seed contains an embryo destitute of albumen.

This family is composed of the genera valeriana, centranthus, fedia, patrinia. Vide Note placed after the Dipsaceæ.

TRANSLATOR'S NOTE.—The root of the valerian, which is perennial, is the part employed in medicine. The herbaceous part, which is annual, does not possess the peculiar properties of the root. The same may be said of the different species of fedia, which are annuals, and so mild as to be used as a salad.

EIGHTIETH FAMILY.

Rubiaceæ.—JUSS. *Opercularieæ.*—J.

IN this family are found herbaceous plants, shrubs, and trees of great stature. Their leaves are either opposite or verticillated. In the first case they present on either side a stipule within the petioles, which adheres to them, and forms a a kind of sheath. The flowers are axillary or terminal, sometimes united in a head. The calyx adhering by its base to the inferior ovary, has its limb entire or divided into four or five lobes, which are more or less deep and persistent. The corolla is monopetalous, regular, epigynous, of four or five lobes. The stamina are of the same number with the lobes of the corolla, and alternate with them. The ovary is inferior, surmounted by a simple or bifid style. This ovary presents two, four, five, or a greater number of cells, each of which contains one or more ovules erect, or attached to the inner angles of the cells. The fruit is very variable; sometimes it is composed of two small one-seeded, indehiscent cells; sometimes it is

fleshy, and contains two one-seeded nuts. In certain genera it is a capsule of two or a greater number of cells, opening into as many valves; or a fleshy, indehiscent fruit. The fruit is always crowned at the top by the limb of the calyx. The seeds, sometimes winged and membranous on their edges, contain in a hard and horny albumen an axile and erect embryo, or sometimes placed in a cross direction with respect to the hilum.

This family, extremely natural, and very easily distinguished, is divided into two principal sections; in the one are placed all the genera with verticillated leaves, such as galium, asperula, rubia, sherardia, crucianella, &c. In the other the more numerous genera, which have their leaves opposite with intermediate stipules, such as cinchona, coffea, cephäelis, psychotria, &c. In Europe we have only the rubiaceæ with verticillated leaves. We unite to this family the group of the opercularieæ, which do not really differ from the other rubiaceæ.

Translator's Note.—This family supplies some of the most valuable articles of the materia medica. The different species of cinchona are tonic and febrifuge. Cephäelis yields the genuine ipecacuanha annulata. Psychotria emetica and richardia brasiliensis furnish two different species of ipecacuan, which contain a smaller proportion of emetine than the annulata. The root of the former is the black ipecacuan of commerce, and by Richard is designated by the name of striata, that of the latter is a species of the white.

Many of the plants of this family are possessed of a remarkable degree of astringency, depending on the presence of tannin and gallic acid. We find it in a slight degree in the cinchona, and from the nauclea gambeer of Hunter, which grows in the East Indies, an extract is obtained, which, on account

of astringency, is by some considered as kino, and has been used for the same purposes.

The roots of the rubia tinctorum, and of some of the other herbaceous species, contain a great proportion of colouring matter, which is employed in dying. The same principle occurs in the barks of the different species of cinchona. The exquisite taste and aroma of the coffee do not belong to the seeds of any other species of the family; yet, in Jamaica, the seeds of the psychotria herbacea, and in our own climate, those of the galium aparine, have been spoken of as substitutes for the fruits of this precious vegetable.

EIGHTY-FIRST FAMILY.

Caprifoliaceæ.—Rich.

Shrubs with opposite leaves, rarely alternate, generally simple, more rarely imparipinnate, without stipules. The flowers are axillary, solitary, or often twin, and partly united together by their calyx, disposed in a cyme, or united in a kind of capitule. The calyx is always monosepalous, adhering by its lower part to the ovary which is inferior. The limb has five persistent teeth. The corolla is monopetalous, in general irregular; sometimes it is formed of five distinct petals. The stamina are five in number, alternate with the divisions of the corolla. The ovary presents from one to five cells, each containing either a single, pendent ovule, or several ovules attached to their inner angle. The style is simple, terminated by a stigma which is very small and slightly lobed. The fruit is sometimes twin, that is to say, formed

by the union of two ovaries. It is fleshy, of one or more cells, sometimes bony, each containing one or more seeds. The latter have a proper integument, sometimes covered by a nut and a fleshy albumen, which contains an axile embryo, having the same direction with the seed.

This family may be easily divided into two natural tribes, accordingly as the cells of the ovary are one-seeded or many-seeded.

1st. The hederaceæ: cells of the ovary one-seeded. Hedera cornus, sambucus, viburnum.

2d. Lonicereæ: cells of the ovary many-seeded. Lonicera, xylosteum, symphoricarpos, &c.

This family allied to the rubiaceæ, differs from them particularly by its irregular corolla and the absence of stipules between the leaves.

TRANSLATOR'S NOTE.—The leaves of the lonicera and of some of the other species of this family are astringent. The berries of the same genus and of the elder are laxative, while the inner bark of the latter acts as a violent purgative. The root of the dwarf elder was used by the ancients in the treatment of dropsy, on account of its purgative properties.

EIGHTY-SECOND FAMILY.

Lorantheæ.—RICH.

THE lorantheæ are mostly perennial plants and generally parasitical. Their stem is woody and branched; their leaves simple and opposite, entire or toothed, coriaceous, persistent, without stipules. Their flowers are variously disposed, some-

times solitary, sometimes in spikes, in racemes or in axillary or terminal panicles. The flowers, in general hermaphrodite, are sometimes diœcious. The calyx adheres to the inferior ovary ; it is entire or slightly toothed. This calyx is accompanied externally by a pair of bracteas, or by a second cup-shaped calyx, sometimes forming a complete covering for the true calyx. The corolla is composed of four to eight petals inserted towards the top of the ovary. These petals are sometimes united, and represent a monopetalous corolla. The stamina are of the same number with the petals ; they are opposite to them, sessile, or borne upon filaments of a variable length. The ovary has but one cell, which contains a reversed ovule. This ovary is crowned by an epigynous, annular disc. The style is often long and slender, sometimes wholly wanting ; the stigma is often simple. The fruit is generally fleshy, containing a single, reversed seed, adhering to the pulp of the pericarp, which is thick and viscid. This seed contains a fleshy albumen, in which is placed a cylindrical embryo, having the radicle turned towards the hilum.

This family, whose genera formerly constituted a part of the caprifoliaceæ, differs from them by its corolla, which is usually polypetalous, its stamina opposite to the petals, and its one-celled and one-seeded ovary. The principal genera of this family are loranthus, viscum, aucuba, &c.

TWELFTH CLASS.

EPIPETALY.

EIGHTY-THIRD FAMILY.

Rhizophoreæ.—R. Rrown.

These are all exotic trees, with simple, opposite leaves and interpetiolar stipules, like the rubiaceæ. Their calyx, adhering to the ovary, presents four or five valvar divisions in its limb, which is persistent. The corolla is composed of four to five petals; the stamina vary from eight to fifteen. The ovary, which is sometimes only half inferior, presents invariably two cells, each of which contains two or a great number of pendent ovules. The style is simple and the stigma bipartite. The fruit, which is crowned at its summit by the calyx, is one-celled, one-seeded, and indehiscent. The seed which it contains is composed of a large embryo, destitute of albumen. This embryo germinates, and is sometimes developed in the interior of the fruit, which it perforates at its summit.

The genera rhizophora, bruguiera and carallia alone compose this family, which differs from the caprifoliaceæ, among which these genera were placed, by their polypetalous corolla, their coriaceous fruit, and their embryo without albumen; and from the lorantheæ by their embryo without albumen.

EIGHTY-FOURTH FAMILY.

Umbelliferæ.—Juss.

One of the most natural families of the vegetable kingdom; the umbelliferæ are herbaceous vegetables, whose stem is often hollow within. The leaves are alternate, sheathing at their base, generally decompounded into a great number of segments or leaflets. The flowers, always very small, white or yellow, are disposed in an umbel. At the base of the umbel there are sometimes found little leaflets, whose union forms the involucre, or the involucel, when placed at the base of the umbellula. Each flower is composed of a calyx adhering to the inferior ovary, whose limb is entire or scarcely toothed; of a corolla formed of five petals, more or less spreading; of five epigynous stamina alternate with the petals; of an ovary of two cells, each containing a reversed ovule, and crowned at its summit by an epigynous and two-lobed disc; of two styles, each terminated by a small simple stigma. The fruit is a diakenium of very various forms, separating at maturity into two one-seeded acheniums, united by a small thread-like column. The seed is reversed, and contains, in a pretty large albumen, a very small, axile embryo.

The genera of this family are very numerous. Among others we shall cite daucus, conium, carum, ammi, scandix, apium, pastinaca, &c.

Translator's Note.—Although this family is very natural with respect to its botanical characters, it is not uniform either in its chemical composition or in its effects on the animal economy. The roots of the parsnip and carrot are very nutritive, while the conium, the cicuta, the œnanthe, &c., are most active poisons, and the seeds of the carum, of the meum, and of many others, contain an essential oil which renders them very agreeable aromatics. To account for this anomaly, it will be necessary to consider the proximate principles contained in these vegetables. These are bitter extractive, resin, and essential oil. Whenever the essential oil and resin predominate, the vegetables shall be aromatic and stimulant. Of this we have examples in the fennel seeds, caraway seeds, &c. These principles are usually found in the fruits; but sometimes they abound in the roots and stems, as in the species that yield gum ammoniac, assafœtida, galbanum, &c. In this situation they are united with mucilage and sugar, and when the proportion of the latter principles is increased by cultivation, as in the case of the carrot and parsnip, the vegetables become fit for use as articles of food.

The warmer the climate, and the dryer the soil, the greater will be the proportion of the aromatic principles, while the poisonous and narcotic principles will prevail in those species which grow in cold and humid situations.

EIGHTY-FIFTH FAMILY.

Araliaceæ.—Juss.

The araliaceæ constitute a group which is hardly distinct from the umbelliferæ. They are

herbaceous vegetables, or sometimes very tall trees. Their flowers, which are very small, are disposed in simple or panicled umbels. Their calyx is adherent and toothed; their corolla formed of five to six petals. Their ovary presents from two to six one-seeded cells, and is surmounted by as many styles, which are terminated by simple stigmas. The fruit is sometimes fleshy and indehiscent, sometimes dry and separating into as many one-seeded cells as there are compartments in the ovary.

This family is very nearly allied to the umbelliferæ, from which it differs by the greater number of its cells, and of its styles, or by its fleshy fruit. Ex. aralia, panax, gastonia, &c.

Translator's Note—The panax quinquefolium is looked upon in China and Tartary as a remedy for all diseases. The roots of this vegetable enter into almost all the medicines employed by the Chinese and Tartars. The generic name, which is of Greek derivation, denotes the universal remedy. Its Chinese name is Ginseng. European physicians think it possesses very little power as a medicine.

THIRTEENTH CLASS.

HYPOPETALY.

EIGHTY-SIXTH FAMILY.

Ranunculaceæ.—Juss.

This great family is composed of herbaceous plants, bearing alternate leaves, sheathing at their

base, usually divided into a great number of segments; in the genus clematis alone they are opposite. The flowers vary much in their disposition. Sometimes they are accompanied with an involucre formed of three leaves, remote from the flowers or close to them, and cup-like. The calyx is polysepalous, often coloured and petaloid, rarely persistent. The corolla is polypetalous, sometimes none. The petals are sometimes simple, with a small depression or glandular lamina at their inner base, oftener irregularly hollowed into a horn or deformed, and suddenly clawed at their base. The stamina are generally very numerous and free, having anthers continuous with the filaments. The pistils are sometimes one-seeded, and collected into a kind of capitule, or many-seeded, and placed circularly, and sometimes more or less intimately united. The style is very short, usually lateral; the stigma simple. The fruits are one-seeded, indehiscent, in capitules or in spikes, or they are aggregated capsules, distinct or united, sometimes solitary, one-celled, many seeded, opening by their inner suture which bears the seeds; very rarely it is a one-seeded berry. The seeds have no arillus. The embryo very small, has the same direction with the seed, and is contained in the base of a fleshy albumen.

The numerous genera of this family may be divided into

two great sections, accordingly as the ovaries are one-seeded or many-seeded.

1°. Ovaries one-seeded.

A. Genera with a calyx and corolla; ranunculus, ficaria, ceratocephalus, myosurus, adonis.

B. Genera without a corolla anemone, clematis, thalictrum.

2°. Ovaries many-seeded.

A. Genera without a corolla: pœonia, caltha.

B. Genera furnished with a corolla.

Trollius, eranthis, helleborus, nigella, garidella, aquilegia, delphinium, aconitum, actæa.

Translator's Note.—All the ranunculaceæ are more or less acrid and poisonous. Their acrimony is supposed to depend on a volatile principle which is dissipated by heat. Accordingly most of them are rendered innoxious by boiling. Hence the necessity of using the inspissated juices of these vegetables for medicinal purposes, instead of their extracts obtained by boiling.

The seeds possess the acrid principle in common with the other parts of the vegetables. It appears, however, to be confined to their integuments, as their kernels are usually mild and oleaginous. The seeds of some of the species are employed for the purpose of killing vermin.

EIGHTY-SEVENTH FAMILY.

Dilleniaceæ.—D. C.

Sarmentaceous trees or shrubs, having their leaves alternate, very rarely opposite, without stipules, often sheathing at their base. The flowers are solitary or in racemes, sometimes opposite to the leaves. Their calyx is monosepalous, per-

sistent, with five deep divisions, imbricated laterally. Their corolla has usually five petals; their stamina very numerous, free, disposed in many rows, are sometimes unilateral and disposed in clusters. The carpels vary from two to twelve; generally distinct, they are sometimes united into one. Their ovary is one-celled, containing two or more ovules attached to the lower part of their inner angle, and erect. The styles are simple, and terminated each by a stigma, which is also simple. The fruits are distinct or united, fleshy or dry and dehiscent. The seeds have a crustaceous integument, covering a fleshy albumen, in which is a very small, erect embryo placed towards the base.

In this family are reckoned the genera tetracera, davilla, delima, pachynema, pleurandra, dillenia, hibbertia, &c. It is distinguished from the magnoliaceæ and the anonaceæ by the number five in the parts of the flower.

EIGHTY-EIGHTH FAMILY.

Magnoliaceæ.—Juss.

This family is composed of large and beautiful trees or of elegant shrubs, adorned with beautiful, alternate leaves, often coriaceous and persistent, furnished at their base with foliaceous stipules. The flowers, often very large, and diffusing a sweet odour, are in general axillary.

The calyx is composed of three to six caducous sepals; the petals vary from three to twenty-seven, disposed in many rows. The stamina very numerous and free, are disposed in many rows, and attached to the receptacle which bears the petals. The pistils are numerous, sometimes united circularly and in one row at the centre of the flower, sometimes forming a capitule, which is more or less oblong. These pistils are composed of a one-celled ovary, containing one or more ovules, of a style scarcely distinguishable, and of a simple stigma. The fruit is composed of dry or fleshy carpels, united circularly and in the form of a star or disposed in capitules, and sometimes all united together. Each carpel is indehiscent, or opens by a longitudinal suture, and the seed is sometimes borne upon a sutural or filiform trophosperm, which hangs out when the fruit opens. These seeds have an erect embryo in a fleshy albumen.

The family of the magnoliaceæ is subdivided into two tribes in the following manner:

1°. Illicieæ: carpels verticillated, rarely solitary by abortion, leaves marked with transparent points. Ex. illicium, drimys, tasmannia.

2°. Magnolieæ: carpels disposed in capitules, leaves not dotted. Ex. magnolia, michelia, talauma, lyriodendron, &c.

This family is very nearly allied to the anonaceæ, from which it differs particularly by its stipules and the continuous structure of its albumen. It has also some affinity to the

dilleniaceæ, which differ from it by the number five in the parts of the flower.

Translator's Note.—These plants are acrid, aromatic stimulants, or intensely bitter, and, in general, they possess all these qualities in variable proportions. To this family belongs the tree which produces Winter's bark (drimys aromatica.) This bark resembles canella alba in its properties and in its effects on the animal economy, but differs from it as to its chemical composition, by containing a small proportion of tannin. It has been successfully used in the treatment of scurvy. The aniseed tree (illicium anisatum,) whose bark, on account of its delicious perfume, is burnt in the Chinese temples, and laid as an offering on the altars of the idols, is also a species of the same family. The fruit has the qualities of the bark in a much higher degree. The barks of the magnolias and of the tulip trees are very bitter and slightly aromatic. They have been used by the North American physicians as substiutes for cinchona in the treatment of intermittents.

EIGHTY-NINTH FAMILY.

Anonaceæ.—Juss.

The anonaceæ are trees or shrubs having alternate, simple leaves without stipules, a character which distinguishes them especially from the magnoliaceæ. Their flowers, usually axillary, are sometimes terminal. Their calyx is persistent, of three deep divisions; their corolla, formed of six petals, disposed in two rows; their stamina are very numerous, forming several rows. Their filaments are short, and their anthers nearly sessile. Their

carpels, generally collected in a great number at the centre of the flower, are sometimes distinct, sometimes united together. Each of them presents a single cell, which contains one or more ovules, attached to its inner suture, and often forming two longitudinal rows. These carpels form so many distinct fruits, (rarely a single fruit by abortion.) Sometimes they are united together and form a kind of fleshy or scaly cone. The seeds have their integument formed of two layers. Their horny albumen is deeply furrowed, containing a very small embryo, placed towards the point of attachment of the seed.

This family, in which are found the genera Anona, Kadsura, Asimina, Uvaria, &c., is nearly allied to the magnoliaceæ, from which it differs especially by the absence of stipules, by the petals whose number never exceeds six, and by the albumen, deeply and irregularly furrowed.

Translator's Note.—The berries of the uvaria are used in the East Indies for the cure of the same disease as cubebs. Different species of the custard apple (anona) are eaten in large quantities by the West Indian negroes, and some are esteemed a delicacy even by the better ranks. The fruits of most of them are soft, pulpy, subacid berries.

NINETIETH FAMILY.

Berberideæ.—Juss.

Herbs or shrubs with alternate leaves, simple or compound, accompanied at their base with sti-

pules, which are often persistent and spinous. Their flowers, generally yellow, are disposed in spikes or racemes. They have a calyx of four to six sepals, rarely more or less numerous, accompanied externally by many scales. Their petals of the same number with the sepals are flat, or concave and irregular; but always opposite to the sepals. They are often furnished at their inner base with small glands or glandular scales. The stamina, in number equal to the petals, are opposite to them. The anthers sessile, or borne upon filaments of a variable length, are two-celled, each cell opening by a kind of valve or lid, as we have already observed in the family of the laurineæ. The ovary has but one cell, which contains from two to twelve ovules, either erect or attached laterally to the inner wall, where they form either one or two rows. The style, sometimes lateral, is either short and thick, or none. The stigma is generally concave. The fruit is dry or fleshy, one-celled and indehiscent. The seeds are composed of a proper integument covering a fleshy or horny albumen, which contains an axile and homotrope embryo.

This family, from which have been removed several of the genera that had been placed in it by M. de Jussieu, is composed of the following: berberis, mahonia, Nandinia, leontice, caulophyllum, epimedium and diphylleia. It is very distinct from all the other families allied to it, by its stamina, which are

opposite to the petals, and by the mode of dehiscence of its anthers.

NINETY-FIRST FAMILY.

Menispermeæ.—Juss.

This family is composed of sarmentaceous and climbing shrubs, whose alternate leaves are generally simple, rarely compound. The flowers are small, unisexual, and generally diœcious. The calyx is composed of several sepals, disposed by threes, and forming several rows. Such is also the structure of the corolla, which is sometimes wanting. The stamina are monadelphous, or free, of the same number with the petals, or of double or triple the number. The pistils often very numerous, free or united by their inner sides, have but one cell, containing one or more ovules. The fruit is a kind of small one-seeded drupe, oblique, and as if reniform, compressed. The seed which it contains is composed of an embryo curved on itself, and generally destitute of albumen.

The menispermeæ, which among others are composed of the genera menispermum, cocculus, cissampelos, abuta, lardizabala, &c., are very nearly allied to the anonaceæ; but they are distinguished from them by their port, which is wholly different, by their stamina, which are generally of a definite number, and by the structure of their fruit.

Translator's Note.—The genuine colombo is said by

Decandolle to be the root of the ꞏcculus palmatus, which grows wild in the forests of the south east of Africa, and in Ceylon. At present, however, it is scarcely found in commerce. The spurious colombo root which is now used in the north of Europe, is said to be imported from North America, and according to Bigelow is the root of the frasera walteri, a plant of the natural order of the gentianeæ. The berries of the cocculus suberosus are used by the Indians for killing fish and birds. They have been employed for the same purpose in Europe; but there is danger in eating of the fish that has been caught by them. They are said to be used in brewing, for the purpose of rendering ale intoxicating.

The pareira brava root (cissampelos pareira,) possesses the characteristic bitterness of this family in a slight degree, and is said to act beneficially in diseases of the urinary organs.

NINETY-SECOND FAMILY.

Ochnaceæ.—D. C.

Woody vegetables, glabrous in all their parts, having alternate leaves with stipules at their base; flowers with peduncles, very rarely solitary, or oftener disposed in branched racemes. Their peduncles are jointed towards their middle. They have a calyx of five deep divisions, imbricated laterally before expansion; a corolla of five to ten spreading petals, imbricated in their æstivation. The stamina vary from five to ten, and are sometimes more numerous, having their filaments free, inserted as well as the petals beneath an hypogynous swelling disc, on which is placed the ovary. The latter is depressed in its centre, and appears to be formed of several distinct pistils, placed around a

central style, which seems to grow immediately from the disc. The style is simple, and bears at its summit a variable number of segments, bearing stigmas. The fruit is composed of the cells of the ovary, which have been separated from each other, and form so many drupaceous carpels, borne upon the disc or gynobasis, which has grown large. These carpels, many of which prove sometimes abortive, are one-celled, one-seeded and indehiscent. They appear to be as it were jointed on the gynobasis, from which they are easily separated. The seed contains a large, erect embryo, destitute of albumen.

To this family are referred the genera ochna, gomphia, walkera, meesia, &c. It has a close affinity to the family of the rutaceæ and more particularly to the tribe of the simaroubeæ, from which it differs by its simple leaves, furnished with stipules, by its erect seeds and indehiscent carpels. On the other hand the ochnaceæ are allied to the magnoliaceæ, and in particular to the genus drimys.

NINETY-THIRD FAMILY.

Rutaceæ.—Adrien De Juss. *Zygophylleæ and Diosmeæ*—Brown. *Simaroubeæ*—Richard.

A large family composed of trees, shrubs, or herbaceous or frutescent plants, having opposite or alternate leaves, very often marked with translucid points, with or without stipules, and flowers in general hermaphrodite, very rarely unisexual. The calyx has three to five sepals, united at the

base ; the corolla five petals, sometimes united together and forming a pseudomonopetalous corolla ; more rarely none. There are five to ten stamina, some of which prove sometimes abortive, and have various forms. The ovary is composed of three or five carpels, more or less intimately united, and forming the same number of ribs, which are more or less prominent. Each cell contains often two, more rarely one, or a considerable number of ovules, inserted at its inner angle, where they form two rows. The styles are free or united. The carpels are generally applied to an hypogynous disc, more or less prominent, and sometimes they form by their union a gynobasic ovary, whose style seems to grow from a very deep depression in its central part. The fruit is sometimes simple, forming a capsule, opening by as many septiferous valves as there are cells ; sometimes, and oftener, they separate into as many cells or carpels, generally one-seeded, indehiscent, and sometimes slightly fleshy, or dry, and opening by two incomplete valves. The seeds, whose proper integument is often crustaceous, is composed of a fleshy or horny albumen, containing an embryo with a superior radicle, rarely turned towards the hilum, which is lateral. Sometimes the embryo is destitute of albumen.

We have adopted the family of the rutaceæ, such as it has been limited by our friend Mr. Adrien de Jussieu, in his excellent work on that family. In it he has united as simple tribes,

the zygophylleæ of Mr. Brown, and simaroubeæ established by my father, and he has divided it into five natural tribes, which are:

1st. The zygophylleæ. Flowers hermaphrodite, cells of the ovary containing two or more ovules, endocarp not separating from the sarcocarp, endorsperm cartilaginous, leaves opposite. Ex. Tribulus, fagonia, guaiacum, zygophyllum.

2nd. The ruteæ. Flowers hermaphrodite, two or more ovules in each cell; endocarp not separating from the sarcocarp, endosperm fleshy, leaves alternate, ex. Ruta, peganum, &c.

3rd. Diosmeæ. Flowers hermaphrodite, two or more ovules; endocarp separating from the sarcocarp, Ex. Dictamnus, diosma, boronia, ticorea, galipea, &c.

4th. The simaroubeæ. Flowers hermaphrodite or unisexual, cells of a single ovule; carpels distinct, indehiscent; embryo without albumen, ex. Simarouba, quassia, simaba, &c.

5th. The zanthoxyleæ. Flowers unisexual, cells containing from two to four ovules; embryo placed in the centre of a fleshy albumen, ex. Galvazia, aylanthus, brucea, zanthoxylum, toddalia, ptelea, &c.

This family has a close affinity to the ochnaceæ, particularly the section of the simaroubeæ, which, like the latter, has a gynobasic ovary; but it differs from them by its reversed seeds, its compound leaves without stipules, &c.

Translator's Note.—All the plants of this family are acrid, aromatic, and slightly stimulant. Some of them are possessed of a high degree of tonic power, and many are distinguished by a strong, peculiar odour. Ruta graveolens, dictamnus albus and diosma crenata are particularly remarkable for the latter quality. The true Angustura bark has the smell of rotten fish, by which it may be distinguished from the false Angustura, with which it has been sometimes adulterated. This circumstance favours the opinion of those who believe it to be the bark of a species of galipea, which belongs to the diosmeæ,

and not of the bonplandia trifoliata, which has been referred to the polemoniaceæ, a family distinguished for no remarkable property.

NINETY-FOURTH FAMILY.

Pittosporeæ.—R. Brown.

Shrubs sometimes sarmentaceous and twining, with simple, alternate leaves without stipules; with solitary flowers, fasciculated or disposed in terminal racemes. Their calyx is monosepalous, of five deep divisions; the corolla is composed of five equal petals united and adhering at the base so as to form a regular, monopetalous, tubular corolla, or else spreading and as if rotate. The five stamina are erect, hypogynous as well as the corolla. The ovary is free, supported upon a kind of hypogynous disc. It presents one or two cells, separated by incomplete partitions, which often do not meet at the centre of the ovary, and hence that organ is one-celled. The ovules are numerous, attached in two longitudinal, distinct rows towards the middle of the partition. The style is sometimes very short, terminated by a small, two-lobed stigma. The fruit is a capsule of one or two many-seeded cells, opening by two valves, or a fleshy, indehiscent fruit. The seeds are composed of a proper integument, which is somewhat crustaceous, of a white and fleshy albumen, of a very small embryo, placed towards the hilum, and having its radicle turned towards that point.

The genera which compose this family were formerly placed among the rhamneæ; but their hypogynous insertion removes them to a great distance from that family. M. De Candolle places the pittosporeæ between the polygaleæ and the frankeniaceæ; but it appears to us that this family should be placed near the rutaceæ, which it resembles in a great many characters. The following are the principal genera of this family: pittosporum, billardiera, bursaria, senacia, &c.

NINETY-FIFTH FAMILY.

Geraniaceæ.—AUGUST. ST. HILLAIRE. *Geraniaceæ, Oxalideæ, Tropæoleæ, Linaceæ.*—D. C. *Balsamineæ.*—A. RICH.

HERBACEOUS or suffrutescent plants with simple leaves or rarely compound, alternate, with or without stipules at their base. The flowers are axillary or terminal. Their calyx is formed of five sepals, often unequal, and united together at their base, sometimes prolonged into a spur. The corolla is composed of five equal or unequal petals, free or slightly adhering at their base. These petals are in general twisted spirally before expansion. The stamina are five to ten in number, rarely seven. They are free or more usually monadelphous by the base of their filaments. Their anthers are two-celled. The carpels are from three to five in number, more or less intimately united, and terminating each in a simple stigma. The fruit is composed of three to five carpels, con-

taining one or two seeds, and remaining indehiscent, or opening by their inner side; or else it is a capsule of five, many seeded cells, opening by five valves, sometimes elastically. The seeds, whose proper integument is sometimes fleshy or crustaceous externally, are composed of a straight embryo, or of one which is more or less curved, immediately covered by the proper integument, or placed in a fleshy albumen.

We have adopted the opinion of M. Auguste de St. Hillaire, who in his Flora of Southern Brazil unites in one family the oxalideæ, the tropœoleæ, the linaceæ and the geraniaceæ of Professor De Candolle. These different families, as well as that which we have established under the name of balsamineæ, form but one and the same family, which should retain the name of geraniaceæ.

1st. Oxalideæ. Leaves usually compound without stipules; flowers axillary; capsule of five many-seeded cells, styles distinct; embryo straight in a fleshy albumen. Ex. oxalis.

2d. Tropœoleæ. Leaves simple without stipules; flowers axillary; three indehiscent one-seeded carpels; embryo without albumen. Tropæolum.

3d. Balsamineæ. Leaves simple without stipules; flowers irregular; no style; capsule of five many-seeded cells, opening elastically; embryo without albumen. Balsamina.

4th. Linaceæ. Leaves simple without stipules; flowers regular and terminal; three or five distinct styles; capsule of five two-seeded cells; albumen thin. Linum.

Geranieæ. Leaves simple without stipules; flowers opposite to the leaves; styles united; carpels indehiscent and the embryo generally without albumen: geranium, erodium, pelargonium, monsonia.

Translator's Note.—This family, as it is here defined, does not exhibit much uniformity in its chemical composition, or in the medicinal virtues of the plants which belong to it. The seeds of the linum contain abundance of mucilage and of fixed oil, and are, therefore, emollient; but yet one species is distinguished as a purgative; while the oxalis yields a great proportion of binoxalate of potash. The nasturtium, from its sensible qualities and its effects on the animal economy, would seem to be more nearly related to the cruciferæ. It is, accordingly, esteemed a powerful antiscorbutic. The geranium robertianum, which is astringent, has been employed as a gargle in affections of the soft palate and of the tonsils.

NINETY-SIXTH FAMILY.

Malvaceæ.—Kunth. *Malvacearum.*—Juss.

This family contains herbaceous plants, shrubs, and even trees with alternate leaves, either simple or lobed, and furnished with two stipules at their base. The flowers are axillary, solitary, or variously grouped, and forming a species of spikes. The calyx is often accompanied externally with a calicule, composed of a variable number of leaflets, and variously united. The calyx is monosepalous, of three or five divisions, adhering like valves before their expansion. The corolla is generally composed of five petals, alternate with the lobes of the calyx, twisted spirally before expansion, often united together at their base by means of the filaments of the stamina, so as that the corolla falls off as a single piece. The stamina are gene-

rally very numerous, rarely of the same number or of double the number of the petals. Their filaments are united and form a tube, and their anthers reniform, and always one-celled. The pistil is composed of several carpels, sometimes verticillated round a central axis, and more or less united together, sometimes collected in a kind of capitule. These carpels are one-celled, containing one, two, or a greater number of ovules, attached to their inner angle. The styles are distinct, or more or less united, and bear each a simple stigma at their summit. The fruit presents the same modifications as the carpels, that is to say, the latter are sometimes united circularly around a material axis, sometimes collected in a head, and forming by their union a many-celled capsule, which opens into as many valves as there are one-seeded or many-seeded cells. At other times the carpels open only by their inner side. The seeds, whose proper integument is sometimes loaded with cotton down, consist of a straight embryo, generally without albumen, having leafy cotyledons folded on each other.

The family of the malvaceæ, such as it is at present limited by botanists, contains but a part of the genera which had been at first united under that name by M. de Jussieu. Ventenat first separated from the malvaceæ the genus sterculia, of which he has formed the type of the sterculiaceæ. M. R. Brown considers the malvaceæ not as a family, but as a large tribe or

class, composed of the malvaceæ of Jussieu, of the sterculiaceæ of the Ventenat, of chlenaceæ of Du Petit Thouard, and of the tiliaceæ of Jussieu. This new family he calls the byttneriaceæ. Our learned friend, Professor Kunth, places in the malvaceæ only the three first sections of Jussieu. He adopts the byttneriaceæ of R. Brown, and adds to them the sterculiaceæ of Ventenat, and lastly he forms a new family by the name of bombaceæ of the genera bombax, cheirostemon, pachira, helicteres, cavanillesia, matisia and chorisia. Thus defined, the family of the malvaceæ is distinguished particularly by its simple petals, its anthers always one-celled, and its seeds generally without albumen. Among the genera which compose it, we shall cite the following: malope, malva, althæa, lavatera, hibiscus, gossipium, palava, lagunea, &c.

Translator's Note.—All the malvaceæ contain in their different parts a considerable quantity of mucilage. They are, therefore, emollient, and may be substituted for each other with very little inconvenience. The young leaves of the mallow are boiled and eaten in several parts of Europe, and the leaves of hibiscus esculentus in Africa and in the East and West Indies.

NINETY-SEVENTH FAMILY.

Bombaceæ.—Kunth.

They are trees or shrubs, natives of intertropical countries, having alternate, simple or digitate leaves, furnished at their base with two persistent stipules. The calyx, sometimes accompanied externally with some bracteas, is monosepalous, of five divisions, which are imbricated before expansion; it is sometimes entire. The corolla, which

is sometimes wanting, consists of five regular petals. The stamina, five, ten, fifteen, or more in number, are monadelphous at their base, and at their upper part form five bundles, each of which bears one or more one-celled anthers. The ovary is formed of five carpels, sometimes distinct, sometimes united together and terminated each by a style and a stigma, which are sometimes united into one. The fruit is in general a capsule of five many-seeded cells, opening by five valves; or it is coriaceous, fleshy within, and remains indehiscent. The seeds, often surrounded by hairs or down, have sometimes a fleshy albumen, covering an embryo, whose cotyledons are flat or rumpled. The albumen is sometimes wanting.

This family, very nearly allied to the former, differs from it chiefly by its calyx being entire, or its lobes not being applied to each other like valves before expansion, by their filaments being disposed in five bundles, and by the structure of their fruit. The genera which compose it are bombax, helicteres, matisia, cavanilisia, adansonia, &c.

TRANSLATOR'S NOTE.—The baobabs (adansonia digitata) are the largest trees in the world, measuring from sixty to eighty feet in circumference. Their fruits contain a reddish spongy substance, full of an agreeable, acidulous juice. This reddish pulp is regarded by the inhabitants of Egypt, Nubia, and Senegal, as very efficacious in the treatment of dysentery. It was formerly imported into Europe by the name of terra sigillata Lemni. The down which envelopes the seeds of the bombax, being destitute of small teeth, cannot be spun into thread like that of the cotton tree.

NINETY-EIGHTH FAMILY.

Byttneriaceæ.—R. Brown. *Malvacearum genera et Hermanniæ.*—Juss. *Sterculiaceæ.*—Ventenat.

Trees or shrubs with alternate, simple leaves, furnished with two opposite stipules. Flowers disposed in racemes, more or less branched, axillary or opposite to the leaves. The calyx, naked or accompanied with a calicule, is formed of five sepals, more or less united at their base, and valvar; the corolla is composed of five flat petals, rolled spirally before expansion, or more or less concave and irregular. These petals are sometimes wanting. The stamina, of the same number with or double the petals, or some multiple of them, are in general monadelphous, and the tube which they form by their union often presents petaloid appendages, placed between the antheriferous stamina, and which are so many abortive stamina. The anthers are always two-celled. The carpels, which are three to five in number, are more or less completely united. Each cell contains two or three ascending ovules, or a greater number, attached to the inner angle of each cell. The styles remain free or are more or less united. The fruit is in general a globular capsule, accompanied by the calyx,

of three or five cells, opening by as many valves, which often bear the partition on the middle of their inner surface. The seeds have an erect embryo in a fleshy albumen.

This family, which is particularly distinguished from the malvaceæ by its two-celled anthers, and its seeds furnished in general with a fleshy albumen, has been divided into six natural sections or tribes.

1st. The sterculiaceæ. Flowers often unisexual, calyx naked, no corolla; ovary pedicelled, formed of five distinct carpels; the albumen is sometimes wanting. Ex. sterculia, triphaca, heritiera.

2d. Byttnerieæ. The petals are irregular, concave, often terminated at their summit by a kind of strap; the stamina are monadelphous, the ovary is five celled, containing in general two erect ovules. Theobroma, abroma, guazuma, byttneria, ayenia, &c.

The lasiopetaleæ. Calyx petaloid; petals very small, in the form of scales, or none; ovary of three to five cells, containing each from two to eight ovules. Seringia, thomasia, keraudrenia, &c.

4th. Hermannieæ. Flowers hermaphrodite, calyx tubular, corolla of five flat petals, rolled spirally before expansion; five monadelphous or free stamina opposite to the petals; cells many-seeded. Melochia, hermannia, mahernia, &c.

5th. The dombeyaceæ. Calyx monosepalous, corolla of five flat petals, stamina equal, numerous, and monadelphous; ovary of three to five cells, containing two or a greater number of ovules. Ruizia, dombeya, pentapetes, &c.

6th. The wallichieæ. Calyx surrounded with an involucre of three to five leaflets, petals flat; stamina very numerous, monadelphous, unequal, and forming a column similar to that of the malvaceæ: Eriolæna, wallichia, gæthea.

Translator's Note.—The seeds of the theobroma cacao are roasted, ground into a fine powder, and mixed with sugar and vanilla, in which state they form the chocolate of commerce. As to their chemical composition, they chiefly consist of a mild fixed oil, which has the consistence of butter, and which has been employed as an ointment and cosmetic.

NINETY-NINTH FAMILY.

Chlenaceæ.—Du Petit Thouars.

This little family is composed of arbuscles, all natives of the island of Madagascar. Their leaves are alternate, furnished with stipules, entire and caducous. The flowers form branched racemes. These flowers are furnished with persistent involucres, which contain one or two flowers. Their calyx is small, formed of three sepals; the petals vary from five to six; they are sessile and sometimes united at their base. The stamina, whose number is ten or indefinite, are monadelphous by their filaments, and sometimes coherent by their anthers. Their ovary is three-celled, surmounted by a simple style and a trifid stigma. The fruit is a three-celled capsule, rarely one-celled by abortion, each cell containing one or more seeds, inserted at their inner angle and pendent. These seeds contain an axile embryo, in a fleshy or horny albumen.

The chlenaceæ, composed of the genera, sarcolæna, lepso-

læna, schizolæna, and rhodolæna, have been classed with the malvaceæ by Du Petit Thouars, on account of their calicule and their monadelphous stamina, &c., and by M. de Jussieu, with the chlenaceæ, on account of their united petals, which form a kind of monopetalous corolla, and of some other characters.

HUNDRED FAMILY.

Tiliaceæ.—Juss. *Tiliaceæ and Elæocarpeæ.*—Juss.

Almost all the Tiliaceæ are trees or shrubs, a small number being herbaceous plants. They bear alternate, simple leaves, accompanied at their base with caducous stipules. Their flowers are axillary, peduncled, solitary or variously grouped. They have a simple calyx, formed of four to five sepals, united like valves before the expansion of the flowers; a corolla of the same number of petals, which are rarely wanting, and are often glandular at their base. The stamina are very numerous, free, and have two-celled anthers; there is often before each petal a pedicelled gland. The ovary presents from two to ten cells, containing each several ovules, attached in two rows at their inner angle. The style is simple, terminated by a lobed stigma. The fruit is a capsule of many cells, containing many seeds, and sometimes indehiscent, or a drupe which is one-seeded by abortion. The seeds contain an embryo, which is straight, or a little curved, in a fleshy albumen.

We include in this family that of the eleocarpeæ of M. De Jussieu, which differs from them only by two characters of little importance; to wit, petals fringed at their summit, and anthers opening only by two pores. We make them a simple tribe of the tiliaceæ, which we divide into two sections, namely,

1st. The true tiliaceæ, comprising the genera tilia, sparmannia, heliocarpus, corchorus, triumfetta, apeiba, &c.

2nd. The elæocarpeæ, in which are the genera elæocarpus, vallea, decadia, &c.

The tiliaceæ have some affinity to the malvaceæ, from which they differ by their free stamina, and their embryo placed in the centre of a fleshy albumen; and to the byttneriaceæ, from which they are distinguished by their free and numerous stamina, their simple style, &c.

HUNDRED AND FIRST FAMILY.

Ternstræmiaceæ and Theaceæ.—Mirbel.

Trees or shrubs with alternate leaves without stipules, often coriaceous and persistent; with flowers sometimes very large, axillary and terminal, having a calyx formed of five concave, unequal and imbricated sepals; a corolla composed of five petals, sometimes united at their base, and forming a monopetalous corolla; numerous stamina, often united by the base of their filaments, and adhering to the corolla. The ovary is free, sessile, in general applied to an hypogynous disc, divided into a number of cells, varying from two to five, containing each two or a greater number of pendent ovules at the inner angle of each cell. The

number of styles is the same with that of the cells. They terminate each by a simple stigma. The fruit presents from two to five cells ; it is sometimes coriaceous, indehiscent, somewhat fleshy internally ; at other times it is dry, capsular, and opening by valves. The seeds, often only two in each cell, have their embryo naked, or covered with a fleshy albumen, which is often very thin.

We think it right to unite into one the two families established by Mirbel, by the names of theaceæ and ternstroemiaceæ. In fact these two families differ very little from each other. They are formed of the genera ternstroemia, thea, camellia, freziera, &c., which had been placed in the family of the aurantieæ, from which they differ by their calyx, the plurality of their styles, by the absence of transparent points, and by an albumen, which, however, is wanting in some of them. On the other hand, this family has some affinity to that of the ebenaceæ, placed among the monopetalous plants. But in general it deserves to be studied anew, and we therefore wait with impatience for the work which our friend M. Cambessedes is preparing on this group and that of the guttiferæ.

Translator's Note.—Thea viridis and thea bohea yield the different kinds of tea that we meet with in commerce. The leaves of these two species are adulterated with those of camellia, and the leaves of the olea fragrans are added in order to communicate an agreeable perfume.

HUNDRED AND SECOND FAMILY.

Olacineæ.—Mirbel.

This little family, formed at the expense of the aurantiaceæ, consists of woody vegetables,

bearing simple, alternate, petioled leaves without stipules, and very small and axillary flowers. The latter are composed of a very small, monosepalous calyx, persistent, entire or toothed, often growing very large and becoming fleshy. The corolla is formed of three to six petals, coriaceous, sessile, valvar, free or united at their base. These petals, which sometimes bear stamina, are often united two and two, being distinct only at the summit. The stamina are in general ten in number, of which many are sometimes abortive and exist under the form of barren filaments. These stamina are immediately hypogynous, or borne upon the petals. The ovary is free, one-celled, containing in general three ovules, which are pendent at the top of a central and erect podosperm.

The style is simple, terminated by a very small and three lobed stigma. The fruit is drupaceous, indehiscent, often covered by the calyx become fleshy, and containing a single seed. The latter consists of a large fleshy albumen, in which is contained a small basilar and homotrope embryo.

This little family, composed of the genera olax, fissilia, &c. is very distinct from the aurantiaceæ by its leaves destitute of dots, its definite stamina, its ovary always one-celled, and its embryo contained in a very large albumen.

According to the celebrated R. Brown, the genus olax is apetalous, that is to say, its flowers have a calyciform involucre, and a calyx formed of three sepals; and, on account of the internal structure of its ovary, this genus should be classed with the santalaceæ.

HUNDRED AND THIRD FAMILY.

Marcgraviaceæ.—Choisy.

Shrubs very often sarmentaceous and climbing, parasitical like the ivy, having alternate, simple, entire, coriaceous and persistent leaves. The flowers are generally disposed in a short spike in the form of a cyme. These flowers, having long peduncles, are sometimes oblique at the top of their peduncle, which very generally bears an irregular bractea, hollow or hood-shaped, or resembling a horn. These flowers are hermaphrodite, having a calyx of four to six or seven sepals, short, imbricated, and generally persistent; the corolla is monopetalous entire, coming off like a sort of coif, or formed of five sessile petals. The stamina, generally very numerous, (five only in souroubea,) have their filaments free. The ovary is globular, surmounted by a sessile stigma, which is lobed like a star, and rarely borne on a style. It presents one cell, which has from four to twelve parietal trophosperms, projecting inwards like half dissepiment, divided at their free edge into two or three layers, variously contorted, and all covered with very small ovules. The fruit is globular, coriaceous, fleshy within, indehiscent, or bursting irregularly into a certain number of valves, which open from the base to the summit, and each of

which bears a trophosperm on the middle of its inner surface. The seeds are very small, and immediately under their proper integument contain the embryo, which is homotropal.

The genera which compose this family are marcgravia, antholoma, noranthea, and souroubea. This group is allied to the guttiferæ; but it is also closely allied to the bixineæ and to the flacourtianeæ, which have also a polypetalous corolla and indefinite stamina, a one-celled fruit, and parietal trophosperms; but in the two latter families the leaves are accompanied with stipules, and the embryo is covered with an albumen.

HUNDRED AND FOURTH FAMILY.

Guttiferæ.—Juss.

This family is composed of trees or shrubs, sometimes parasites, and all full of a yellow and resinous proper juice. Their leaves opposite, or more rarely alternate, are coriaceous and persistent; their flowers disposed in axillary racemes or terminal panicles, are hermaphrodite or unisexual and polygamous; their calyx is persistent, formed of two to six rounded sepals, often coloured; the corolla is composed of four to ten petals, the stamina very numerous, rarely definite, free. The ovary is simple, surmounted by a short style, which is sometimes wanting, and which bears a peltate and radiated, or a many lobed stigma. The fruit is sometimes capsular, sometimes fleshy or drupaceous, opening sometimes by many valves, whose

edges, generally re-entrant, are fixed to a single placenta or to many thick placentas. The seeds are composed of an homotropal embryo without albumen.

The guttiferæ comprise a great number of genera, all exotic, such as clusia, godoya, mahurea, garcinia, calophyllum, &c. They differ particularly from the hypericineæ by their stamina completely free, their proper juice, which is milky, and by the absence of transparent points.

Translator's Note.—The fruit of the garcinia mangostana is reckoned one of the most delicious in the world. It is considered not inferior even to the pine apple. In the East, it is the only fruit that sick people are allowed to eat without any scruple. The fruit of the American mammee tree, which belongs to this family, and even of the garcinia cambogia, are also eaten, either raw or preserved in wine or sugar. But yet all the other parts of the same plants contain a yellowish milky juice, which is more or less acrid and purgative. That of the g. cambogia, which is a native of the East Indies, is used in medicine as a drastic purgative, and is much esteemed by painters as producing a bright yellow colour.

HUNDRED AND FIFTH FAMILY.

Hypericineæ.—Juss.

Herbaceous plants, shrubs, or even trees, often resinous, and covered with transparent glands, having opposite, very rarely alternate, simple leaves. The flowers are axillary or terminal, and variously grouped. Their calyx is of four or five

very deep divisions, somewhat unequal. The corolla is composed of four to five petals, rolled spirally before expansion. The stamina are very numerous, united in many bundles by the base of their filaments, sometimes monadelphous or free. The ovary is free, globular, surmounted by many styles, sometimes united and growing into one. It has the same number of many-seeded cells as of styles. The fruit is a capsule or a berry of many cells with many seeds. In the first case it opens into as many valves, continuous by their edges with the partitions, as there are cells. The seeds, very numerous and very small, contain an homotropal embryo without albumen.

This family, composed of a small number of genera, such as hypericum, androsæmum, ascyrum, vismia, &c., bears also the name of millepertuis, because most of the species have transparent miliary glands in the substance of their leaves, which, viewed between the eye and the light, seem to be so many small holes. This character, together with that of the very numerous stamina, and many-seeded cells of the fruit, perfectly distinguishes the hypericineæ from all the neighbouring families.

Translator's Note.—These plants are, in general, aromatic, resinous, and their juice is sometimes purgative. Several of the American species, such as the h. bacciferum, the h. cayennense, yield a juice, which in the solid state is known by the name of American gamboge. The hypericum perforatum was formerly esteemed an excellent vermifuge, and the tutsan (h. androsæmum,) as its name denotes, was considered a cure for all diseases.

HUNDRED AND SIXTH FAMILY.

Aurantiaceæ.—Correa. *Auantiorum genera.*—Juss.

Very glabrous trees or shrubs, sometimes spinous, bearing alternate, jointed leaves, simple, or more usually pinnate, furnished with vesicular glands, filled with a transparent volatile oil. The flowers are odorous and generally terminal. Their calyx is monosepalous, persistent, of three to five divisions, more or less deep; their corolla of three to five petals, sessile, free, or slightly united. The stamina, sometimes of the same number with the petals, or double or some multiple of that number, are free, or variously united by their filaments, and are attached beneath the hypogynous disc which supports the ovary. The latter is globular, of many cells, containing a single pendent ovule, or many ovules, attached to the inner angle of the cell. The style, sometimes very short and very thick, is always simple, terminated by a discoid stigma, simple or lobed. The fruit is generally fleshy within, separated into many cells by thin membranous partitions, containing one or more seeds inserted at their inner angle, and generally pendent. Externally, the pericarp is thick and indehiscent, full of vesicles containing a volatile oil. The seeds contain one, and sometimes several embryos, without albumen.

The genera which compose this family are particularly distinguished by their jointed leaves, often compound, furnished with vesicular glands, which exist also in the substance of their petals and of their pericarps; by their simple style, and their seeds without albumen. Ex. Citrus, limonia, murraya, &c.

Translator's Note.—Two species of the citrus are employed in medicine for the sake of the acid juice of their fruits, of their bitter rinds, and of the essential oil contained in their flowers, their leaves and their pericarps. All the other species, with their numerous varieties, are possessed of similar properties. The shaddock (citrus decumana) sometimes weighs fourteen pounds, and is seven or eight inches in diameter. It is a native of China and Japan, and was brought to the West Indies by Captain Shaddock, from whom it has taken its name. The bergamot (citrus bergamia) is esteemed for its essential oil, which, like that of the lemon, is obtained either by distillation or pressure from the rind of the fruit.

HUNDRED AND SEVENTH FAMILY.

Ampelideæ.—Rich. *Vites.*—Juss.

Twining shrubs or trees, sarmentaceous and furnished with tendrils opposite to the leaves. The latter are alternate, petioled, simple or digitate, furnished at their base with two stipules. The flowers are disposed in racemes opposite to the leaves. The calyx is very short, often entire and nearly flat; the corolla of five petals, sometimes cohering by their upper parts, and falling off together in the form of a coif. The stamina, five in number, are erect, free, and opposite to the petals. The

ovary is applied to an hypogynous, annular disc, which is lobed in its circumference. It always presents two cells, each containing two erect ovules. The style, which is thick and very short, terminates in a scarcely two lobed stigma. The fruit is a globular berry, containing from two to four erect seeds, having their episperm thick, their endosperm horny, and containing towards the base a very small erect embryo.

This little family, composed of the genera vitis, cissus and ampelopsis, is very distinct by its leaves, furnished with stipules, its tendrils opposite to the leaves, its stamina opposite to the petals, and the structure of its fruit and its seeds.

Translator's Note.—The best varieties of dessert grapes are those produced in Britain. The fruit is of a larger size and of a better flavour than in any other part of the world. The species cultivated are the vinifera, the labrusca, and the laciniosa ; but there are nearly as many varieties as there are vineyards. Those which are most esteemed for wine-making are such as have small berries with an austere taste. The Burgundy, as modified by soil and situation, is considered to be the most general vineyard grape of France.

HUNDRED AND EIGHTH FAMILY.

Hippocraticeæ.—Juss. *Hippocrateaceæ.*—Kunth, D. C.

Small trees and shrubs, generally glabrous and sarmentaceous, bearing opposite, simple, coriaceous, entire, or toothed leaves ; and small axil-

lary flowers, either fasciculated or in corymbs. The calyx is persistent, of five divisions; the corolla is composed of five equal petals. The stamina are generally three in number, rarely four or five, having their filaments united at their base, and forming a tubular androphorum. The ovary is triangular, three-celled, each cell containing four ovules attached to the inner angle. The style is simple, terminated by one or three stigmas. The fruit is sometimes capsular, with three membranous angles, sometimes fleshy. Each cell contains in general four seeds. The latter have an erect embryo without albumen.

This family, composed of the genera hippocratea, anthodon, raddisia, salacia, &c., is allied to the acerineæ and the malpighiaceæ.

HUNDRED AND NINTH FAMILY.

Acerineæ.—D. C.

A FAMILY composed exclusively of the genus acer, and having the following characters. Flowers hermaphrodite or unisexual; calyx of five more or less deep divisions, or entire. Corolla of five petals; stamina of double that number, inserted on an hypogynous disc, which occupies the whole bottom of the flower. The ovary is thin and compressed, of two cells, containing each two ovules, attached to the inner angle. Style simple,

sometimes very short, terminated by two awl-shaped stigmas. The fruit is composed of two indehiscent samaras, expanded on one side into wings. The seeds, under their proper integument, have an embryo which is rolled spirally.

The acerineæ are trees with opposite leaves, either simple or pinnate, and with flowers disposed in racemes or in terminal cymes. They stand between the malpighiaceæ, from which they chiefly differ by their membranous fruit, which is winged and only two-celled, and the hippocastaneæ.

The family of the acerineæ, such as it had been established by Jussieu, contained several other genera, such as æsculus, which forms the family of the hippocastaneæ of De Candolle, and which appears to us to belong to the malpighiaceæ, and hippocratea, which is the type of the hippocrataceæ.

HUNDRED AND TENTH FAMILY.

Malpighiaceæ.—Juss.

A family composed of trees or shrubs with opposite leaves, either simple or compound, often furnished with hairs resembling a rape seed (pili malpighiacei,) often accompanied at their base with a pair of stipules. Flowers, yellow or white, forming racemes, corymbs or sertules, either axillary or terminal. The pedicelli which support the flowers are often jointed, and furnished with two small bracteas towards their middle. Their calyx is monosepalous, often persistent, of four to five deep divisions; their corolla, which is some-

times wanting, is composed of five petals with long claws. The stamina, ten in number, rarely fewer, are free, or slightly united at their base. The pistil is sometimes simple, sometimes formed of three carpels, more or less united. Each carpel or each cell contains either a single ovule suspended at the upper part of the inner angle, or two ovules attached to the same angle. The styles, three in number, are sometimes united. The fruit, which is dry or fleshy, is composed of three distinct carpels, or forms a capsule or a nuculanium of three cells; rarely of two or of one cell. The capsule is usually covered with membranous wings, very prominent, or with spinous points. The nuculanium contains sometimes three one-celled nucules, sometimes a nut of three one-seeded cells. Each seed is composed of a proper integument of little thickness, immediately covering a somewhat curved embryo.

This family, in which, among others, we find the genera malpighia, byrsonima, hyptage, gaudichaudia, banisteria, &c., is allied to the acerineæ and hypericineæ. It is distinguished from the former by its petals having a long claw, its monadelphous stamina, and the cells of its fruit being always one-seeded. From the second, by its definite stamina, its one-seeded cells, &c. We unite to this family the genus æsculus, which forms the family of the hippocastaneæ of M. De Candolle.

Translator's Note.—The bark of the horse chesnut (æsculus hippocastanum) has an astringent bitter taste, and has

been proposed as a substitute for cinchona in the treatment of intermittents.'

The seeds are almost wholly composed of fecula; but they also contain a bitter principle, which gives them a very disagreeable taste. When deprived of this principle by being macerated in an alkaline ley, they have served as food for horses, cows, sheep and goats, which are very fond of them.

The fruits of the malpighia urens and m. glabra are eaten in the West Indies under the name of Barbadoes cherries.

HUNDRED AND ELEVENTH FAMILY.

Erythroxyleæ.—Kunth.

Trees or shrubs with alternate or opposite leaves, generally glabrous, furnished with axillary stipules. The flowers are small, pedicelled, having a persistent calyx of five deep divisions; a corolla of five petals without a claw, and furnished internally with a small scale. The stamina, ten in number, are monadelphous. The ovary is one-celled, containing a single pendent ovule, or it has three cells, two of which are empty. From the ovary arise three styles, sometimes distinct, sometimes united almost to their summit. The fruit is a one-seeded drupe, containing an angular seed, whose albumen, which is hard and horny, contains an axile and homotropal embryo.

This little family consists only of the genus erythroxylum, placed formerly among the malpighiaceæ, and of a new genus established by M. Kunth under the name of sethia. It differs

from the malpighiaceæ by its petals having appendages, its one-seeded fruit, and its embryo furnished with an albumen.

HUNDRED AND TWELFTH FAMILY.

Meliaceæ.—Juss. D. C. *Cedreleæ.*—R. Brown.

Trees or shrubs with alternate leaves without stipules, simple or compound; with flowers sometimes solitary and axillary, sometimes variously grouped in spikes or in racemes, having a monosepalous calyx of four or five divisions more or less deep; a corolla of four or five valvar petals; stamina generally double the number of the petals, rarely of the same number, or of a more considerable number. These stamina are always monadelphous, and their filaments form a tube, which bears the anthers, sometimes at its top, sometimes at its inner surface. The ovary is supported on an hypogynous annular disc; it presents four to five cells, containing generally two ovules, which are collateral and placed one above the other. The style is simple, terminated by a stigma more or less deeply divided into four or five lobes. The fruit is sometimes dry, capsular, opening into four or five septiferous valves; sometimes it is fleshy and drupaceous, and sometimes it is one-celled by abortion. The seeds are composed of an embryo, sometimes covered with a

thin or fleshy albumen, which is wanting in other genera.

The genera ticorea and cusparia, formerly placed in this family, have been removed by R. Brown into the rutaceæ. The same botanist has formed of the genera cedrela and swietenia, a distinct family under the name of cedreleæ. But Professor De Candolle has simply made them a tribe of the meliaceæ. This family is divided into two natural tribes, namely:

1st. The true meliaceæ: the cells of the fruit containing one or two seeds without either wings or albumen; embryo reversed; cotyledons flat and leafy, or thick and fleshy. Ex. geruma, humiria, turræa, quivisia, strigilia, sandoricum, melia, trichilia, guarea, &c.

2d. Cedreleæ. Cells of the fruit many-seeded, seeds generally winged, furnished with a fleshy albumen, embryo erect, cotyledons leafy. Ex. cedrela, swietenia, &c.

This family, a-kin to the sapindaceæ and ampelideæ, differs from them by its stamina, which are always monadelphous, and by the structure of its fruit.

Translator's Note.—The plants of this family are not considered to be remarkably uniform in their effects on the animal economy. The bark of the canella alba is aromatic and stimulant, that of the bead tree (melia,) is nauseous, and that of the swietenia febrifuga is bitter and febrifuge. The bark of the cedrela tuna is employed in the East Indies as a cure for intermittents. The pulpy fruit of the melia azedarach yields a fixed oil, which is chiefly used for lamps. This fruit and the olive are the only examples known of a pericarp containing fixed oil.

HUNDRED AND THIRTEENTH FAMILY.

Sapindaceæ.—Juss.

This family is composed of large trees or shrubs, sometimes of herbaceous twining plants, bearing alternate leaves, usually imparipinnate, sometimes furnished with tendrils. Their calyx is composed of four to five sepals, free or slightly united at their base. The corolla, which is sometimes wanting, is usually formed of four to five petals, which are sometimes naked, sometimes glandular towards their middle part, where they sometimes bear a petaloid lamina. The stamina, double the number of petals, are free, and applied to an hypogynous disc, which is flat and lobed, and lines the entire bottom of the flower. The ovary has three cells, containing in general two ovules placed the one above the other, and attached to the inner angle of each cell. The style, simple at its base, is trifid at its summit, and terminates in three stigmas. The fruit is a capsule, which is sometimes vesicular, of one, two, or three cells, containing each a single seed. The seeds are composed of a large embryo, with its radicle curved back on the cotyledons, and destitute of albumen.

This family is divided into three tribes, in the following manner:

1st. Paullinieæ. Petals with appendages, disc formed of distinct glands, placed between the petals and the stamina; ovary of three one-seeded cells; twining herbs or shrubs, furnished with tendrils. Ex. cardiospermum, urvillea, serjania, paullinia.

2d. Sapindeæ. Petals without appendages, but glandular or bearded, rarely naked; disc annular, or sometimes composed of glands united together; ovary of two or three one-seeded cells; trees or shrubs not twining. Ex. sapindus, talisia, schmidelia, euphoria, thoninia, cupania, &c.

3d. Dodoneaceæ. Petals furnished with a scale at their base; ovary of two or three cells containing two ovules; pericarp vesicular or winged; embryo having cotyledons rolled spirally. Ex. kolreuteria, dodonæa, &c.

Translator's Note.—The pulpy fruit of the soap berry, is used in America for washing linen. Hence its name sapindus, which is a contraction for sapo indicus. It is said, however, to burn and destroy the linen when repeatedly used.

HUNDRED AND FOURTEENTH FAMILY.

Polygaleæ.—Juss.

We find in this family herbaceous plants or shrubs, with alternate, simple, entire leaves; with solitary axillary flowers, or in spikes. Each is composed of a calyx of four to five sepals, imbricated laterally before the expansion of the flower, and two of which, sometimes more internal, are petaloid and coloured. The corolla is formed of two to five petals, sometimes distinct, sometimes united together by means of the filaments of the

stamina, which form a tube cleft on one side. The stamina, generally eight in number, are monadelphous; their androphorum is divided at the top into two phalanges, each of which bears four one-celled anthers, opening usually at the top. More rarely the stamina are two to four in number, and free. The ovary is sometimes accompanied at its base by a disc which is hypogynous and unilateral, or formed of two lateral and lamellar appendages. It presents two, more rarely one or three cells, containing each one or two ovules. The style is long, usually recurved, and bearing a hollow two-lobed and unilateral stigma. The fruit is a capsule or a drupe. In the first case it consists of two one-seeded cells, and opens by two septiferous valves; in the other case it is one-celled, one-seeded and indehiscent. The seeds are pendent, in general accompanied with a sort of caruncle or arillus of various forms. The embryo is sometimes placed in a fleshy albumen, and is sometimes without albumen.

The genus polygala had been formerly placed by M. De Jussieu in the family of the pediculares. My father, by shewing that its corolla was truly polypetalous, has pointed out the necessity of making it a distinct family, which M. De Jussieu more recently established under the name of polygaleæ. This family approaches in the general form of its flower to the leguminosæ and fumariaceæ; but from its characters it should be placed near the droseraceæ and tremandreæ of Mr. R. Brown.

Besides the genus polygala there are reckoned in this family the genera salomonia, comesperma, badiera, soulamea, krameria, &c.

Translator's Note.—The polygala vulgaris, which is the only indigenous species, is said to possess properties similar to those of the polygala Senega.

The roots of the species composing the genus krameria are very astringent. Those of the k. ixina, which grows in St. Domingo, might be substituted for the roots of the k. triandra, which is a native of Peru. According to Dr. Reece, the extract of rhatany is employed by the Portuguese merchants to improve the colour and flavour of port wine.

HUNDRED AND FIFTEENTH FAMILY.

Tremandreæ.—R. Brown.

This little family, formed of only two genera, is composed of shrubs having the port of heaths, all natives of New Holland, bearing alternate or verticillated leaves without stipules, simple or toothed, and often with glandular hairs. Their flowers are axillary and solitary, having a calyx of four to five unequal sepals, approximated in the form of valves before the expansion of the flower, and caducous. The corolla is formed of four to five equal petals, alternate with the sepals, longer than the stamina. The latter, from eight to ten in number, are placed in pairs opposite to each petal; their anthers, which have two or four cells, open at the top by a small pore or a kind of tube. The ovary is oval, compressed, two-celled, contain-

ing each two or three pendent ovules. The style is terminated by one or two stigmas, and the fruit is a compressed, two-celled capsule, opening by two valves, septiferous on the middle of their surface. The seeds inserted at the top of the dissepiment are terminated by an appendage in the shape of a caruncle. The embryo is erect, in a fleshy albumen.

This family has numerous affinities to the polygaleæ, from which it differs by its free stamina, its anthers of two or four cells, its regular corolla, and to the droseraceæ, from which it is distinguished by its anthers, the cells of its ovary, which contain but two or three ovules, &c.

HUNDRED AND SIXTEENTH FAMILY.

Fumariaceæ.—D. C.

The fumariaceæ are all herbaceous plants, not lactescent, having alternate leaves, decompounded into a great number of narrow segments ; flowers rather small, generally disposed in terminal spikes. Their calyx is composed of two very small sepals, opposite, flat, and caducous; the corolla is irregular, tubular, formed of four unequal petals, sometimes slightly united at their base ; the upper, which is the larger, terminates at its lower part in a short spur, which is curved backwards. The stamina, six in number, are diadelphous, that is to say, they form two androphora, each of which bears three

anthers at its summit, the middle of which is two-celled, and the two lateral ones are each one-celled. The ovary is one-celled, and contains four, or a great number of ovules, attached to two longitudinal placentas, corresponding to each suture. The style is short, surmounted by a depressed stigma. The fruit is at one time a globular achenium, one-seeded by abortion, at other times a capsule, which is sometimes vesicular, many-seeded, and opening by two valves. The seeds are globular, furnished with a caruncle, and containing in a fleshy albumen, a small embryo, which is somewhat lateral, sometimes recurved, and placed transversely.

This family, composed of the genus fumaria, and of genera established from its different species, such as corydalis, diclytra, cysticapnos, &c. is distinguished from the papaveraceæ by the absence of a milky juice, an irregular corolla, and six diadelphous stamina.

Translator's Note.—None of the plants contained in this family is poisonous. On the contrary, they all appear to possess some degree of tonic power, which resides in the bitter juice contained in their stems and leaves.

HUNDRED AND SEVENTEENTH FAMILY.

Papaveraceæ, Papaveracearum, gen.—Juss.
Podophyllearum, gen.—D. C.

Herbaceous, or more rarely suffrutescent plants, with alternate, simple leaves, or more or

less deeply divided, usually full of a white or yellowish milky juice. The flowers are solitary or disposed in cymes or in branched racemes. The calyx is formed of two, very rarely of three concave and very caducous sepals. The corolla, which is sometimes wanting, is composed of four, very rarely of six petals, flat, rumpled and plicate before their expansion. The stamina, very numerous, are free. The ovary is ovate or globular, or narrow, and as it were linear. It is one-celled, containing a great number of ovules attached to projecting placentas in the form of plates or of false dissepiments. The style, which is very short, or scarcely distinguishable, terminates by as many stigmas as there are trophosperms. The fruit is an ovate capsule, crowned by the stigma, indehiscent, or opening by simple pores beneath the stigma; or else it is oblong, in the shape of a pod, opening by two valves, or bursting transversely by joints. The seeds, usually very small, are composed of a proper integument, bearing sometimes a sort of small fleshy caruncles, and of an albumen, also fleshy, in which is placed a very small cylindrical embryo.

M. de Jussieu had included in his papaveraceæ the genus fumaria, which, better studied, is become the type of a distinct family. The genera of the papaveraceæ are, papaver, argemone, meconopsis, sanguinaria, bocconia, rœmeria, glaucium, chelidonium and hypecoum.

We include in this family podophyllum and jeffersonia, which form one of the tribes of the family podophylleæ of M. de Candolle, in which family, besides the two genera now mentioned, the celebrated professor places cabomba and hydropeltis, which form a perfectly distinct family, belonging to the monocotyledonous plants. *Vide* Cabombeæ.

Translator's Note.—The plants of this family contain an acrid milky juice, which acts with great energy on the animal economy. Many of them have besides a narcotic power, which is most remarkable in the poppies. The degree of this power varies with the species, and is found greatest in the p. somniferum. It is also influenced by climate, insomuch that there is little chance of ever producing opium in this country that shall equal the East Indian or the Persian. With us the poppy is cultivated for the sake of its capsules, which are employed in fomentations, and in preparing a syrup.

With the exception of the Argemone Americana, whose seeds are poisonous, the seeds of all the papaveraceæ are mild and oleaginous. The p. somniferum is cultivated in many parts of Europe, for the purpose of preparing a fixed oil from its seeds, which is used in domestic economy as a substitute for olive oil.

HUNDRED AND EIGHTEENTH FAMILY.

Cruciferæ.—Jussieu.

One of the largest and most natural families of the vegetable kingdom, composed of herbaceous, or sometimes suffrutescent plants, growing for the most part in Europe. Their leaves are alternate, simple, or more or less deeply incised; their flowers disposed in spikes, or in simple or panicled ra-

cemes. The calyx is composed of four caducous sepals, two of which are sometimes gibbous at their base. The corolla consists of four petals with claws, opposite in the form of a cross (hence the name cruciferæ.) The stamina, six in number, are tetradynamous, that is to say, there are four larger, approximated two and two, with two shorter, which are opposite. At the base of the stamina, there are on the receptacle, two or four glands, of which one is placed between each pair of long stamina, and a larger one is placed within each of the shorter. The ovary is more or less oblong, and has two cells separated by a false partition. Each cell contains one or more ovules attached to the outer edge of the membranous partition, which is only a prolongation of the two sutural placentas. The style is short, or almost none, and seems a continuation of the partition; it terminates by a two-lobed stigma. The fruit is a silique or a silicule, of variable form, indehiscent or opening by two valves. The seeds are attached on each side of the dissepiment. Their embryo is immediately covered by the proper integument; it is more or less recurved upon itself.

The genera which compose this family are extremely numerous. Linnæus divided them into two orders, accordingly as the fruit was a silicule or a silique. In the first we find, among others, the genera lepidium, thlaspi, isatis, myagrum, cochlearia, iberis, lunaria, &c. In the second, the genera cheiranthus, sisymbrium, hesperis, brassica, eruca, sinapis, &c.

Translator's Note.—This family coincides with the class tetradynamia of Linnæus.

In Smith's Flora Britannica the subdivisions of the genera in the order siliquosa, are founded on diversities in the structure of the embryo, which, for the sake of beginners, it may be useful to explain.

The cotyledons may be applied to the embryo in different ways. When the cotyledons, being flat, have their edges so applied to the radicle as that a transverse section of the embryo would be represented thus, o =, they are said to be flat, accumbent; when their flat surface is applied to the radicle, in which case the section would be thus, o ||, they are said to be flat, incumbent. If, in the latter case, the cotyledons are half-folded, so as to have the section thus O ⋙, they are conduplicate, incumbent. These are the three sections of the order siliquosa in the last edition of Smith's Botany. This arrangement has been adopted from De Candolle, by whom all the genera contained in this family have been subdivided on similar principles.

All parts of the cruciferæ contain an essential oil which is heavier than water, and their seeds contain besides a variable proportion of a mild fixed oil. The latter is obtained by pressure from the seeds of the several species, as for instance from those of the myagrum sativum, of the colza (brassica campestris) and of the rape (b. napus) in France and other parts of the continent, where it is used for lamps and other purposes of domestic economy.

The stimulant effects of the cruciferæ depend on the essential oil, and are very remarkable in the seeds of the mustard, and in the roots of the horse radish. When the proportion of their mild and mucilaginous parts is increased by cultivation, the roots and leaves of many of the species are used as articles of food. Of this we have examples in the cabbage (brassica oleracea) and its numerous varieties, and in the turnip, (brassica rapa.) The antiscorbutic virtues of the cruciferous plants, as

well as their power of producing vesication, depend on their essential oil. When the seeds of mustard are used for sinapisms, their power is considerably augmented by pressing out their fixed oil. They contain sulphur, perhaps dissolved in the oil, and nitrogen, which becomes the basis of the ammonia that is generated when they undergo the putrefactive fermentation.

HUNDRED AND NINETEENTH FAMILY.

Capparideæ.

These are herbaceous plants or woody vegetables, which bear alternate leaves, simple or digitate, accompanied at their base by two foliaceous stipules; their flowers are terminal, in the form of spikes or racemes, or axillary and solitary; their calyx is composed of four caducous sepals, very rarely united together at their base; the corolla, formed of four to five equal or uneqnal petals; the stamina are sometimes of a definite number, sometimes, and more usually their number is indefinite; the ovary is simple, often raised on a support, which is more or less oblong, called podogynium, at the base of which are inserted the stamina and petals; it presents a single cell, containing many placentas, projecting in the form of plates or false partitions, bearing a great number of ovules. The fruit is dry or fleshy. In the first case it is a kind of silique which is more or less oblong, opening by two valves, as in most of the cruciferæ. In the second case, it is a berry, one-

celled and many-seeded, whose seeds are parietal, or seem scattered in the pulp which fills the fruit. These seeds are generally reniform, composed of a dry, and as it were crustaceous episperm, immediately covering an embryo which is somewhat recurved and destitute of albumen.

Among the genera which compose this family we shall cite the following, capparis, cratæva, morisonia, boscia, cleome, &c. M. De Jussieu had placed in his family of the capparideæ many genera which are become the types of distinct families. Thus reseda forms the family of the resedaceæ; drosera, parnassia, aldrovanda and dionæa the droseraceæ; marcgravia and norantea the marcgraviaceæ.

The capparideæ bear the closest affinities to the cruciferæ; but they differ from them by their leaves furnished with stipules, their numerous stamina, and the structure of their fruit.

Translator's Note.—Like the last family, several species of the capparideæ are possessed of a high degree of stimulant power. The root of the capparis spinosa is diuretic, and its pickled flower buds, which are used as a condiment, are regarded as antiscorbutic. Several species of cleome have the taste of mustard, and in the East Indies the cleome icosandra is employe d as a sinapism.

HUNDRED AND TWENTIETH FAMILY.

Resedaceæ.—D. C.

Plants generally herbaceous, rarely suffrutescent, with alternate leaves without stipules, often furnished with two glands at their base. The

flowers form simple or terminal spikes. The calyx presents from four to six deep and persistent divisions. The corolla is composed of the same number of petals, alternate with the sepals of the calyx. These petals are in general composed of two parts, the one inferior, entire, the other superior, divided into a more or less considerable number of segments. The stamina are generally of an indeterminate number (from fourteen to twenty-six) their filaments are free and hypogynous; their anthers two-celled, opening each by a longitudinal groove. On the outside of the stamina, that is to say between the petals and the filaments, there is a kind of annular cup, glandular, more elevated at the upper part, and thus forming an hypogynous disc of a peculiar nature. The pistil, slightly stipitated at its base, appears formed by the intimate union of three carpels, and terminates at the upper part by three horns, each of which bears a stigma at its summit. This ovary has one cell, open at the top, containing a great number of ovules, attached to three parietal placentas, which have the remarkable peculiarity of not corresponding to the stigmas, but of alternating with them. The fruit, seldom fleshy, is usually a capsule, more or less oblong, naturally open at the top, which terminates in three angles. It is one-celled, and the seeds are attached to three parietal placentas. The seeds very often reniform, are composed of a rather

thick integument, of a very thin, fieshy albumen, and of an embryo recurved in the form of a horse-shoe.

This family is composed of the genus reseda and of ochradenus of M. Delile. The genus reseda had been placed by M. De Jussieu in the family of the capparideæ, and it must be admitted that it has several points of agreement with that family, and in particular with the genus cleome. But M. Tristan has made it the type of a distinct family, adopted by Decandolle, and placed by the former of these botanists among the passifloreæ and the cisteæ, but nearer to the latter. In his Collectanea Botanica, t. xxii. Mr. J. Lindley has given quite a different explanation of the flower of reseda. With this botanist, the calyx is a common involucre, each petal is a barren flower, and the nectary or disc is a proper calyx which surrounds an hermaphrodite flower, composed of stamina and of a pistil. According to this view Mr. Lindley places the resedaceæ near the euphorbiaceæ, which have a nearly similar disposition, But still we are of opinion that this family cannot be separated from the capparideæ and the cisteæ.

HUNDRED AND TWENTY-FIRST FAMILY.

Flacourtianeæ.—Rich. *Bixineæ.*—Kunth.

Shrubs with alternate, simple leaves, often alternate, coriaceous, persistent, and without stipules; with peduncled and axillary flowers, often unisexual and diœcious, at other times hermaphrodite. The calyx is formed of three to seven sepals, distinct or slightly united at their base. The corolla, which is sometimes wanting, is composed

of five or seven petals, alternate with the sepals. The stamina of a definite or indefinite number, have their filaments free, their anthers two-celled; these stamina, as well as the petals, are inserted on the circumference of an hypogynous, annular disc, which is rarely wanting. The ovary is sessile or stipitated, globular, one-celled in all the genera of the family except flacourtia, which has from six to nine cells. In the first case it contains a great many ovules attached to parietal placentas, whose number is the same with that of the stigmas or lobes of the stigmas. The fruit is one-celled, except in flacourtia; it is dehiscent or indehiscent, and each of the valves bears a placenta on the middle of its inner surface. In general the proper integument of the seed is fleshy, and the embryo, which is homotropal and straight, is placed in the centre of a fleshy albumen.

The genera which compose this family appear to us not to be as yet determined with sufficient accuracy. Their essential character consists in parietal placentas, simple or more usually spread and ramified in the form of veins, which line the inner wall of the ovary, as has been already remarked in regard to the tribe butomeæ of the family of the alismaceæ. Perhaps it would be proper to add to the flacourtianeæ the family of the bixineæ, established by our learned friend Professor Kunth, and which appears to us not to differ much from it. The principal genera which compose the flacourtianeæ, are flacourtia, roumea, kiggelaria, erythrospermum, &c. This family has some affinity to the cappárideæ, from which it differs particularly

by its embryo furnished with a fleshy albumen, and by its seeds inserted on the middle and not on the edge of the valves. It has also some affinity to the cisteæ and the tileaceæ.

Translator's Note.—The fruit of the arnotta (bixa orellana) is remarkable for yielding the red substance which is used in England for colouring cheese, in Holland for colouring butter, and which is employed by the American Indians as a paint for their bodies.

HUNDRED AND TWENTY-SECOND FAMILY.

Cisteæ.—D. C. *Cistorum Genera.*—Juss.

They are herbaceous, annual, or perennial plants, or woody shrubs, bearing leaves which are often opposite, entire, and sometimes furnished with two stipules; axillary or terminal flowers, solitary or in spikes, racemes or sertules. Their calyx has three or five very deep divisions, sometimes equal, sometimes unequal, two being external to the rest. Their corolla has five petals, rumpled, very caducous, spread like a rose and sessile; the stamina are very numerous and free; the ovary globular, rarely one-celled, oftener five or ten-celled, containing several ovules inserted on the inner edge of the partitions. In the one-celled ovary, the ovules are attached to parietal placentas. The style and stigma are simple. The fruit is a globular capsule enveloped in the calyx, which is persistent, having one, three,

five or even ten cells, and opening by three, five, or ten valves, bearing each one of the partitions or one of the placentas on the middle of its inner surface. The seeds, very numerous in each cell, contain an embryo more or less recurved, or rolled spirally, in a fleshy albumen.

This little family is composed only of the genera cistus and helianthemum. Such as it had been established by M. De Jussieu in his Genera Plantarum, it contained the genera viola, piparea, piriqueta, and tachibota, which at present form the family of the violarieæ.

Translator's Note.—Ladanum is collected from the cistus creticus, by means of rakes which have leathern thongs instead of teeth. In the time of Dioscorides, it was obtained from the beards of the goats that browsed among the cistus on the mountains. It may be procured from several other species as well as the creticus. It is at present used only in perfumery.

HUNDRED AND TWENTY-THIRD FAMILY.

Droseraceæ.—D. C.

Herbaceous plants, annual or perennial, rarely suffrutescent, having alternate leaves, often furnished with glandular, pedicelled hairs and circinated before expansion. Their calyx is monosepalous, of five deep divisions, or of five distinct sepals; their corolla of five flat and regular petals; the stamina five, or sometimes ten in number, are alternate with the petals, and free;

sometimes before each petal there are appendages of various forms. These stamina are generally perigynous and not hypogynous, as has been heretofore stated. The ovary consists of one cell, rarely of two or three. In the first case it contains a great number of ovules attached to three or five parietal placentas, simple or bifid; in the second case the partitions seem formed by the placentas projecting in the form of plates, which meet and unite in the centre of the ovary. The stigmas, generally of the same number with the trophosperms or cells, are sessile and radiating. The fruit is a capsule of one or more cells, opening only by its upper half into three, four, or five valves, bearing one of the placentas on the middle of their inner surface. The seeds, often covered with a loose tissue, contain an erect, nearly cylindrical embryo, within a thin albumen, which is sometimes wanting.

The genera referred to this family by M. De Candolle, are drosera, aldrovanda, romanzoffia, byblis, roridula, drosophyllum, dionæa, and parnassia. But in treating with some detail of the characters of this family in the 5th tome of the Dictionaire Classique d'Histoire Naturelle, article Droseraceæ, page 624, we have shewn the necessity of separating from them, 1st, dionæa, whose insertion is really hypogynous, and whose seeds are all attached to the bottom of the capsule, and which perhaps is more allied to the hypericeæ. 2d. Romanzoffia, which belongs to the scrophularieæ. The family of the droseraceæ differs from the violarieæ, which it closely resembles, by its perigynous insertion, the absence of stipules, and the constant regularity of the flower, &c.

HUNDRED AND TWENTY-FOURTH FAMILY.

Violarieæ.—D. C.

Herbs or shrubs with alternate leaves, very rarely opposite, furnished with two persistent stipules. The flowers are peduncled, axillary. The calyx is composed of five sepals, either free or slightly united at their base, which is sometimes prolonged beneath their point of attachment. They are equal or unequal. The corolla is composed of five unequal petals, the lower of which is prolonged at the base into a spur, which is more or less lengthened. Very rarely the corolla is formed of five regular petals. The stamina, five in number, are nearly sessile, approximated and laterally contiguous, with two-celled introrse anthers. The two which are placed near the lower petal are often furnished with an appendage in the shape of a curved horn, which grows from their dorsal side, and is prolonged into a spur. The ovary is globular, one-celled, containing a great number of ovules attached to three parietal placentas. The style is simple, somewhat curved at the base, swelled towards the upper part, which terminates in a slightly lateral stigma, with a small, semicircular depression. The fruit is a one-celled capsule, opening by three valves, each

of which bears a placenta on the middle of its inner surface. The seeds contain an erect embryo in fleshy albumen.

The violarieæ, which are composed of the genera viola, ionidium, hybanthus, noisettia, conhoria, alsodeia, &c., are distinguished particularly from the cisteæ by their irregular corolla, their five stamina, their swelled and concave stigma, &c. They are also allied to the polygaleæ and droseraceæ, &c.

Translator's Note.—The roots of several species of viola are emetic, and particularly those of the odorata, the canina, the tricolor, and the arvensis. One species of the white ipecacuanha of commerce is the root of the ionidium ipecacuanha of Brasil. The roots of the other species have similar properties, and have been used as substitutes for the genuine ipecacuanha. They contain less of emetine, and, therefore, require to be taken in larger doses in order to act as emetics.

HUNDRED AND TWENTY-FIFTH FAMILY.

Frankeniaceæ.—Aug. St. Hilliare.

The frankeniaceæ are herbaceous or suffrutescent; their leaves are alternate or verticillated, entire or serrated, with their lateral nerves very close, furnished at the base with two stipules, which are wanting only in the genus frankenia. The flowers are axillary, disposed in simple or compound racemes, or in panicles. These flowers are hermaphrodite. Their calyx is formed of five sepals, slightly united at their base; the corolla of five petals equal or unequal. In the genus sauva-

gesia there is observed an additional verticil of filaments swelled into the shape of a club, and an inner corolla, which also exists in the genus luxemburgia. The stamina are five or eight in number, or indefinite. They are free, their anthers being two-celled, extrorse, and opening by a longitudinal slit or a pore. The ovary ovate, oblong, or triangular, is often placed upon an hypogynous disc. It has one cell, containing three parietal trophosperms, each bearing a great number of ovules. The style is slender, terminating in a very small stigma. The fruit is a capsule, covered by the calyx or by the inner corolla, having one cell, which opens by three valves, whose edges slightly re-entrant, form three incomplete partitions bearing the seeds. The latter, in the centre of a fleshy albumen, contain an axile embryo, which is cylindrical and homotropal.

This little family is composed of the genera frankenia, lavradia, sauvagesia, and luxemburgia. It has the closest affinity to the cisteæ, the violareæ, and the droseraceæ; but it differs from them particularly in the dehiscence of its capsule, whose valves bear the seeds upon their re-entrant edges, while the placentas are placed on the middle of the inner surface of the valves in the preceding families.

HUNDRED AND TWENTY-SIXTH FAMILY.

Caryophylleæ.—Jussieu.

The caryophylleæ are herbaceous, rarely suffrutescent at their base; their stems are often

naked and jointed; their leaves, opposite or verticillated, are simple; their flowers, generally hermaphrodite, are terminal or axillary. Their calyx is composed of four to five distinct sepals, or united together and forming a simply cylindrical or vesicular tube, simply toothed at the summit. The corolla of five petals, usually clawed at the base, is rarely wanting; the number of stamina is equal to or double the petals. In the latter case, five are alternate with the petals, and five are opposite to them and united below with the claws. They are all inserted on an hypogynous disc, which supports the ovary. The latter presents from one to five cells. If one-celled, the ovules, which are numerous, are attached to a central placenta; if many-celled, they are attached to the inner angle of each cell. The styles vary from two to five, and each terminates in an awl-shaped stigma. The fruit is a capsule, rarely a berry, having from one to five many-seeded cells. This capsule opens either at the top, by means of small teeth which separate from one another, or by complete valves. The seeds are sometimes flat and membranous, sometimes rounded. They contain an embryo which is curved, or as it were rolled round a farinaceous albumen.

Several genera formerly placed in this family, have been withdrawn from it, and united to some others taken from the amaranthaceæ. Together they form the new family of the

paronychieæ, which are distinguished particularly by their perigynous insertion ; such are the genera polycarpon, læflingia, minuartia, queria. The genera linum and lechea, which had formed the family of the linaceæ, have been added to the geraniaceæ. Frankenia is become the type of the family of the frankeniaceæ ; sarothra has been transferred to the hypericineæ.

The genera of this family may be divided into two tribes, to wit :

1st. The diantheæ, which have a monosepalous, tubular calyx, petals with long claws : dianthus, silene, lychnis, agrostemma, cucubalus, &c.

2d. The alsineæ, whose calyx is spreading, and petals without a claw : arenaria, alsine, spergula, cerastium, mollugo, &c.

FOURTEENTH CLASS.

PERIPETALY.*

HUNDRED AND TWENTY-SEVENTH FAMILY.

Paronychieæ.—Aug. St. Hillaire.

Herbaceous or suffrutescent plants bearing opposite leaves, often connate at the base, with or without stipules ; flowers very small, axillary or

* Besides the families whose characters we have traced, several others also belong to the same class, but as their characters are as yet not perfectly determined, or as they are composed of only a small number of genera, we have thought it our duty to pass them over in a work of this kind. Such are, 1st the escalloneæ (R. Brown,) allied to the saxifrageæ. 2d. The stackhouseæ (R. Brown,) consisting only of the genus stack-

terminal, naked or accompanied with scarious bracteas. Their calyx monosepalous, often persistent, presents five divisions, which are more or less deep. Very often they form a tube at its upper part, which is often thickened by a glandular intumescence. The petals, five in number, very small or squamiform, or even none, are inserted at the top of the calycine tube. The stamina, also five in number, of which some are occasionally abortive, are alternate with the petals and have their anthers introrse. The ovary is free, and has one cell containing a single ovule, placed at the top of a basilar podosperm, sometimes very long, and in this case the ovule is reversed; at other times, several ovules are attached to a very short central trophosperm. The stigma is sometimes sessile and simple, sometimes it is bifid and supported on a very short style. The fruit is a capsule, dehiscent by means of valves or clefts, or else it remains closed. Besides the proper integument, the seeds are composed of a cylindrical embryo, applied to one of the sides, or rolled round a farinaceous albumen. The radicle is always turned towards the hilum.

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housia. 3d. The chaillettieæ (R. Brown.) 4th. The aquilarineæ (R. Brown,) intermediate between the rhamneæ and terebinthaceæ, the first containing he genera chailletia, leucosia and tassura, and the second the genera aquilaria, ophispermum and gyrinops.

This family, established by Aug. De St. Hillaire, is composed of genera taken from the amaranthaceæ, the portulaceæ, and caryophylleæ, from which they particularly differ by their perigynous insertion, while in two of those families it is hypogynous. We have divided the genera of the paronychieæ into two tribes:

1st. The scleranthеæ, which contain the genera that have no bracteæ, whose calycine divisions are not scarious on the edges; leaves without stipules and connate. Ex. læfflingia, minuartia, queria, scleranthus, mniarum and larbrea.

2d. The true paronychieæ, whose genera have their flowers furnished with bracteas; their calycine divisions scarious on the edges, often fleshy and hollowed into a groove; the leaves accompanied with stipules. Ex. gymnocarpus, paronychia, illecebrum, anychia, herniaria, polycarpon, hagea, &c.

HUNDRED AND TWENTY-EIGHTH FAMILY.

Portulaceæ.—Juss.

Herbaceous plants rarely frutescent, having opposite leaves, sometimes alternate, thick, and fleshy, without stipules; flowers generally terminal. Their calyx is generally formed of two sepals, more or less united, and often as it were tubular at the base. The corolla is formed of five petals, either free or slightly united together, and forming a monopetalous corolla. The stamina are of the same number with the petals, inserted at their base, and are opposite to them; more rarely they are more numerous. The ovary is free or almost half inferior, with one cell containing a

variable number of ovules, growing immediately from the bottom of the cell, or attached to a central trophosperm. The style is simple, terminated by three or five filiform stigmas. The fruit is a one-celled capsule, containing three or more seeds, and opening either by three valves, or by two valves placed the one above the other. The seeds under their proper integument, which is often crustaceous, contain a cylindrical embryo, which is rolled upon a farinaceous albumen.

Several genera, formerly placed in this family, have been removed from them. Thus tamarix forms the family of the tamariscineæ, which differs especially by the absence of albumen. The genera scleranthus, gymnocarpus, and probably telephium and corrigiola, have been transferred into the new family of the paronychieæ, which differ from them only by their stamina which are alternate and not opposite to the petals, their simple or bifid stigma, and not three or five cleft.

The genera which remain among the portulaceæ are portulaca, talinum, montia, &c.

HUNDRED AND TWENTY-NINTH FAMILY.

Ficoideæ.—Jussieu.

They are in general succulent plants like the crassulaceæ, having their leaves alternate or opposite; their flowers often very large, axillary or terminal. Each of them presents a monosepalous calyx, often campanulate or persistent, having its limbus sometimes coloured, and of four or five

lobes; a polypetalous corolla, whose petals are sometimes of an indefinite number, at other times united into a monopetalous corolla; more rarely the corolla is wanting. The stamina are generally pretty numerous, free and distinct. The ovary is sometimes wholly free, sometimes adhering by its base to the calyx; it presents from three to five cells, containing each several ovules, attached to a placenta, which grows from the inner angle of each cell. This ovary is surmounted by three to five cells, terminated each by a simple stigma. The fruit is sometimes a berry, sometimes a capsule surmounted by the calyx, of three or five many-seeded cells. The seeds have an embryo rolled round a farinaceous albumen.

This family is closely allied to the portulaceæ, from which it differs by its petals and its stamina, generally very numerous, by its plurality of styles, and its ovary of three or five cells, and not one-celled, as in the portulaceæ. The principal genera of the family of the ficoideæ are: reaumuria, mesembryanthemum, nitraria, tetragonia, &c. This family, which by its port approaches to the crassulaceæ, differs from them by its simple ovary.

HUNDRED AND THIRTIETH FAMILY.

Saxifrageæ.—Juss. *Cunoniaceæ*.—R. Brown.

The saxifrageæ are herbaceous plants, rarely shrubs or trees, whose leaves are alternate or opposite, simple and sometimes compound, with or

without stipules. The flowers sometimes solitary, sometimes differently grouped in spikes, racemes, &c., present a monosepalous calyx, tubular below, where it is united with the ovary, terminated above by three or five divisions. The corolla, which is very rarely wanting, is composed of four to five petals, sometimes united by their base; the stamina are in general double the number of petals, sometimes of an indefinite number. The ovary is of two, more rarely of four or five cells; it is sometimes wholly free, sometimes half inferior or nearly inferior, terminated at its top by as many styles as there are cells. The latter usually contain several, very seldom a single ovule. The ovules are attached to a placenta placed along the partition. The fruit, which is rarely fleshy, is generally a capsule, terminated above by two horns more or less prolonged, opening in general by two septiferous valves. The seeds present, under their proper integument, a fleshy albumen, which contains an axile homotrope embryo, sometimes a little recurved.

This family, to which we add the cunoniaceæ of Mr. R. Brown, which differs from them only by their woody stem, is composed of the genera saxifraga, heuchera, tiarella, cunonia, weinnmannia, &c.

Translator's Note.—The roots of the saxifraga granulata are bitter, slightly acrid and astringent. A decoction of them prepared in the proportion of half an ounce to a pint of water, has been often used as a diuretic. The generic name

of the plant is derived from its supposed efficacy in the cure of urinary calculi.

HUNDRED AND THIRTY-FIRST FAMILY.

Hamamelideæ.—R. Brown.

These are shrubs with alternate simple leaves, often furnished with caducous stipules. The flowers are axillary, having a calyx composed of four sepals, sometimes united into a tube at their lower part, and adhering to the ovary, which is half inferior. The corolla is composed of four long, linear, valvar petals, a little twisted before the expansion of the flower. The stamina are four in number, alternate with the petals, having their anthers introrse and two-celled, opening by a valve, which is sometimes common to both cells, and which occupies their inner surface. Before each petal there is often found a scale of various forms, which appears to occupy the place of an abortive stamen. The ovary is half inferior, or wholly free, of two cells, containing each a suspended ovule. From the top of the ovary grow two styles, terminated each by a single stigma. The fruit enveloped in the calyx is dry, of two one-seeded cells, opening in general by two septiferous valves. The seeds are composed of an homotropal embryo, covered by a fleshy albumen.

The genus hamamelis, which forms the type of this family,

had been placed by M. De Jussieu at the end of the berberideæ, but its insertion is perfectly perigynous. Mr. R. Brown has proposed to establish for this genus a distinct family under the name of hamamelideæ. He, moreover, refers to this family the genera dicoryphe and dahlia, and unites to them fothergilla, which, however, differs from them in many characters. It is next to this new family that the illustrious English botanist thinks his family of the bruniaceæ ought to be placed. As to the hamamelideæ themselves, they appear to us to be closely allied to the saxifrageæ.

HUNDRED AND THIRTY-SECOND FAMILY.

Bruniaceæ.—R. Brown Ad. Brong.

The plants which compose this family are shrubs, which by their port have a close resemblance to heaths, and to the phylica or heaths of the Cape of Good Hope. They are all natives of the Cape. Their leaves are very small, stiff, entire, sometimes imbricated ; their flowers are small, disposed in capitules, more rarely in panicles. The calyx is monosepalous, of five divisions, adhering in general by its base to the ovary, which is inferior, or half inferior, (it is free in the genus raspalia alone ;) the five divisions are imbricated, as well as the corolla before their expansion. The petals are five in number, and alternate. The five stamina are alternate with the petals, and their filaments adhere laterally to the base of each of the petals, which made some authors suppose that

they were opposite to the petals. The ovary is half inferior or inferior, or else it is free, of one or three cells, each containing one or two collateral and suspended ovules. The style is simple or bifid, or the two styles are distinct and terminated each by a very small stigma. The fruit is dry, crowned by the calyx, corolla, and stamina, which are persistent; indehiscent or separating into two cells, usually one-seeded, opening by a longitudinal cleft at the inside. The seeds are suspended, containing a very small homotrope embryo, placed at the base of a fleshy albumen.

This little family, first noticed by R. Brown (in Abel. Iter. Chin.) has been adopted by M. De Candolle (Prod. Syst. 2. p. 43.) M. Adolphus Brongniart has made it the object of a special memoir, in which he has better traced both the characters of the family and those of the genera which compose it. The genus brunia, which forms its type, had been placed by M. De Jussieu near phylica in the family of the rhamneæ; but it differs from them by many characters, such as its stamina alternate and not opposite to the petals; its ovules often twin and suspended, and not solitary and erect, &c.

Mr. Brown thinks the bruniaceæ ought to be placed near the hygrobieæ and hamamelideæ, while M. De Candolle places them in the neighbourhood of the rhamneæ. In his work on this family M. Brongniart enumerates the following genera: berzelia, brunia, raspalia, staavia, berardia, linconia, audoninia, tittmannia, and tamnea.

HUNDRED AND THIRTY-THIRD FAMILY.

Crassulaceæ.—D. C. *Semperviveæ.*—Juss.

This family is composed of herbaceous plants, or of shrubs, whose leaves, stems, and in general all the herbaceous parts, are thick and fleshy. These leaves are alternate or opposite. Their flowers, which sometimes present very vivid colours, have different modes of inflorescence. Their calyx is deeply divided into a great number of segments, their corolla is composed of a variable number, sometimes very great, of regular petals, distinct or united into a monopetalous corolla. The number of stamina is the same with, or more rarely double the petals, or lobes of the monopetalous corolla. At the bottom of the flower there are usually found several distinct pistils, whose number varies from three to twelve, and sometimes beyond it. Each of them is composed of an ovary more or less lengthened, of one cell, containing several ovules, attached to a sutural, internal placenta. The style and stigma are simple. The fruit is a one-celled, many-seeded capsule, opening by a longitudinal suture at the inside. The seeds present an embryo more or less recurved, in some degree covering a farinaceous albumen.

This family, composed of succulent plants, has, by its many-seeded, one-celled capsules, which open by a single longitudinal

suture, some affinity to the genera of the family of the ranunculaceæ, which have the same character. But it is still more allied to the saxifrageæ and ficoideæ, from which it differs especially by its distinct pistils in the centre of the flower. The principal genera are tillæa, bulliardia, crassula, cotyledon, bryophyllum, sedum, sempervivum.

HUNDRED AND THIRTY-FOURTH FAMILY.

Nopaleæ.—Vent. *Cactus.*—Juss.

This family is composed exclusively of the genus cactus of Linnæus and of the divisions established in it. They are perennial, often arborescent plants, to which there is nothing analogous except in some euphorbiaceæ. Their stems are either cylindrical, branched, channelled, angular, or composed of jointed pieces which have been considered as leaves. The leaves are almost constantly wanting, and are replaced by spines united in clusters. The flowers, which are sometimes very large, and distinguished by the brilliancy of their colours, are in general solitary, and placed in the axilla of one of the bundles of spines. Their calyx is monosepalous, adhering to the inferior ovary, sometimes scaly externally, terminated at the top by a limbus, composed of a great number of unequal lobes, which are confounded with the petals. The latter are in general very numerous, and disposed in many rows. The stamina, also very numerous, have slender capil-

lary filaments. The ovary is inferior, of one cell, containing a great number of ovules attached to parietal placentas, whose number is very variable, and usually corresponds with that of the stigmas. The style is simple, terminated by three or a greater number of radiating stigmas. The fruit is fleshy, depressed at the summit. The seeds have a double integument, and contain a straight or recurved embryo, destitute of albumen.

M. De Jussieu had united in this family with the genus cactus, the genus grossularia, of which M. De Candolle has formed his family of ribesiaceæ.—See below the differences which exist between these two families.

Translator's Note.—The fruits of the cacti are watery and insipid, but they are eaten in the West Indies, where they are indigenous, on account of their refreshing moisture and coolness. The juice of some of them is of a red colour, which they communicate to the urine, when eaten. The fruit of the cactus cochinillifer is the proper food of the coccus insect, which derives its peculiar colour from that of the fruit on which it feeds. When the insect is fed on the other species it is of inferior quality.

HUNDRED AND THIRTY-FIFTH FAMILY.

Ribesieæ.—Rich. *Glossularieæ.*—D. C.

Bushy shrubs, sometimes spinous, having alternate leaves without stipules; axillary, solitary flowers, twin or disposed in spikes, or in simple racemes. Their calyx is monosepalous, tubular

below, where it adheres to the ovary, having its limb widened, and as it were bell-shaped, of five divisions, spreading or reflexed; their corolla is formed of five petals, sometimes very small; the stamina of the same number with the petals, and alternate with them, are inserted towards the middle of the calycine limb. The ovary is inferior, of one cell, containing a great number of ovules, attached in many rows to two parietal placentas. The two styles are more or less united together, and each is terminated by a simple stigma. The fruit is a globular berry, depressed at the top, many seeded, and its seeds are composed of a large embryo immediately covered by the proper integument.

The genus ribes alone, to which might be added, perhaps, the genus gronovia, formerly placed in the cucurbitaceæ, composes this family. It is very nearly allied to the nopaleæ, from which it differs, especially by the very different port of the vegetables which compose it, by their petals and their stamina, constantly five in number, and not of an indeterminate number as in cactus, by their two placentas and two styles. In another work, (Medical Botany, p. 487,) I have proposed to divide the numerous species of this genus into three sections, or sub genera having for their type, the one ribes uva crispa, the other ribes nigrum, and the third ribes rubrum. I have called the first grossularia, the second ribes, and the third botrycarpum.

Translator's Note.—The fruits of this family contain malic and citric acids with albumen, vegetable jelly, and sugar, and some of them contain colouring matter. The presence of

the colouring matter serves to shew their affininity to the family of the cacti, with which they were formerly united. As, containing malic acid, which is never precipitated, they are less adapted for making wine than grapes, from whose juice the tartaric acid subsides in the state of bitartrate of potash.

HUNDRED AND THIRTY-SIXTH FAMILY.

Cucurbitaceæ.—Juss.

Large herbaceous plants often twining, covered with short and very stiff hairs. Their leaves are alternate, petioled, more or less lobed. Their tendrils, which are simple or branched, grow near the petioles. The flowers are in general unisexual and monœcious, very rarely hermaphrodite. The calyx is monosepalous; in the female flowers it presents a globular tube, adhering to the inferior ovary; its limb, which is more or less campanulate and five lobed, is confounded and intimately united with the corolla, and has nothing distinct but the top of its lobes. The corolla is formed of five petals, united together by means of the calycine limb, and thus representing a monopetalous corolla. The stamina, five in number, have their filaments monadelphous, and united in three bundles, two formed each of two stamina, and the third of a single stamen. The anthers are one-celled, linear, curved in the shape of ∽, placed horizontally, and whose branches are very close. In the female flowers, the top of

the inferior ovary is crowned by an epigynous disc. The style is thick, short, terminated by three thick stigmas, and often two-lobed. This ovary has but one cell in the two genera (sicyos and gronovia.) It contains a single pendent ovule; but in general it presents three parietal, triangular, very thick placentas, contiguous to each other by their sides, and thus filling the whole cavity of the ovary, and giving attachment to the ovules at their point of origin on the walls of the ovary. The fruit is fleshy, depressed at the top; it is a peponida. The seeds, when the fruit is ripe, seem scattered in the midst of a cellular tissue, either filamentous or fleshy. The proper integument is pretty thick, and immediately covers a large homotrope embryo, destitute of albumen.

The principal genera of this family are cucumis, cucurbita, pepo, ecballium, momordica, bryonia, gronovia, &c. It has very close affinities to the family of the onagrarieæ, from which it is very well distinguished by the structure of its perianth, and especially by that of its fruit. It is also closely allied to the nopaleæ and ribesieæ. As to the genus passiflora, which was first placed in this family, it is become the type of a distinct order under the name of passifloreæ.

Translator's Note.—The roots of the perennial species of these vegetables contain fecula and an acrid principle which renders them purgative. Of this we have examples in the bryony and elaterium. The same property is found in the fruits of the colocynth, elaterium and snake gourd (trichosan-

thes amara.) But in the fruits of several other species there is a great deviation from the law of uniformity. Thus the cucumber (cucumis sativus,) and the melon (c. melo,) are eaten either alone or as a condiment. The same may be said of the bottle gourd (cucurbita lagenaria,) the pumpkin (c. pepo,) and the squash gourd (c. melopepo.) The water melon (cucurbita citrullus,) is reckoned one of the most delicious fruits that warm climates can produce. It is said to serve the Ægyptians for meat, drink, and physic. De Candolle is of opinion, that the influence of cultivation will in some degree account for this anomaly.

HUNDRED AND THIRTY-SEVENTH FAMILY.

Loaseæ.—Juss.

Herbaceous, branching plants, often covered with hispid hairs, and whose sting is burning, like that of nettles ; their leaves are alternate or opposite, entire or variously lobed. Their flowers, very often yellow and large, are sometimes solitary, sometimes variously grouped. They have a monosepalous, tubular calyx, either free or adhering to the inferior ovary, having five divisions in its limb ; a corolla of five regular petals, flat or concave; the throat of the calyx is sometimes furnished with five appendages or a divided border. The stamina generally very numerous, are sometimes of the same number with the petals. The ovary is free or inferior, of one cell, presenting internally three parietal placentas, sometimes pro-

jecting in the form of partitions, and bearing several ovules. This ovary is surmounted by three long, slender styles, sometimes united into one, and terminated each by a stigma, which is either simple or pencil-shaped. The fruit is a capsule, crowned by the lobes of the calyx, or naked, opening only at the top by three valves, which bear one of the placentas on the middle of their inner surface, except in the genus loasa, where the placentas correspond with the sutures. The seeds, which have sometimes an arillus, present an homotropal embryo in a fleshy albumen.

This family is composed of the genera loasa, mentzelia klaprothia, to which M. Kunth has added turnera and piriqueta. It has much affinity to the onagrarieæ and the nopaleæ, but differs from them by very striking characters. Thus in the onagrarieæ the ovary is many-celled; the stamina are of a determinate number, &c. In the nopaleæ the fruit is fleshy and the seeds without albumen.

HUNDRED AND THIRTY-EIGHTH FAMILY.

Passifloreæ.—Juss.

Herbaceous plants or shrubs with sarmentaceous stems, furnished with extra-axillary tendrils, and alternate leaves: either simple or lobed, and accompanied with two stipules at their base. More rarely they are trees destitute of tendrils. Their flowers are in general large and solitary; more

rarely they form a kind of raceme. These flowers are hermaphrodite, having a monosepalous, turbinated calyx, or with a longish tube, of five more or less deep divisions, sometimes coloured; a corolla of five petals, inserted at the top of the tube of the calyx; five stamina, monadelphous at their base, and forming a tube which covers the support of the ovary, and adheres to it; the anthers are versatile and two-celled. On the outside of the stamina there are appendages of very various forms, sometimes filamentous, sometimes in the form of scales or pedicelled glands, united circularly, and forming from one to three crowns, which grow at the orifice and on the parietes of the calycine tube. Sometimes these appendages and even the corolla, are completely wanting. The ovary is free with a longish stipe, of one cell, presenting from three to five longitudinal placentas, which sometimes project in the form of false partitions, and which give attachment to a great number of ovules. It is surmounted by three or four styles, terminated by as many simple stigmas: rarely the stigmas are sessile. The fruit is fleshy internally, containing a great number of seeds; more rarely it is dry, but always indehiscent. The seeds have a fleshy albumen, in which is an homotropal, axile embryo.

According to Jussieu the passifloreæ, as well as the cucur-

bitaceæ, have but a simple perianth, and the organ which we have described as a corolla, and which is wanting in some genera, ought to be compared to the numerous appendages which adorn the tube of the calyx. Whatever may be the opinion adopted on this subject, it will still be a very difficult matter to determine the place of the passifloreæ in the series of natural orders. They appear to us to have but very slight affinities to the cucurbitaceæ, among which the genus passiflora had been placed. But yet there may be discovered some remote affinity between them and certain families of polypetalous plants, and in particular the capparideæ, and above all the loaseæ, near which, in our opinion, they ought to be arranged.

The passifloreæ are composed of the genera passiflora, tacsonia, murucuja, malesherbia, deidamia, kolbia, and probably carica, placed also among the cucurbitaceæ.

Translator's Note.—The fruit of the passiflora maliformis is called granadilla in the West Indies, where the plant is indigenous. It contains a sweetish pulp, and, as well as the fruits of several other species, is eaten by the inhabitants. The syrup and decoction of the p. murucuia are used in the leeward parts of Jamaica as a substitute for opium.

HUNDRED AND THIRTY-NINTH FAMILY.

Hygrobieæ.—Rich. *Cercodiennes.*—Juss. *Halorageæ.*—R. Brown.

A small family, chiefly composed of aquatic plants, often bearing verticillated leaves, very small axillary flowers, and sometimes unisexual, having a monosepalous calyx adhering to the inferior ovary, and terminated above by a limb of three

or four lobes. The corolla, which is sometimes wanting, is composed of three to four petals, alternate with the lobes of the calyx. The number of stamina is equal to or double the petals, to which in the first case, they are opposite. The ovary presents from three to four cells, each of which, contains a single reversed ovule. From the top of the ovary arise three or four filiform stigmas, either glandular or downy. The fruit is a berry or a capsule, crowned by the lobes of the calyx, of many one-seeded cells. Each seed, which is reversed, contains in a fleshy albumen, a cylindrical and homotrope embryo.

The genera which compose this family, had been formerly placed among the onagrarieæ and nayades. These genera are myriophyllum, haloragia, cercodia, proserpinaca, trixis, &c. It differs from the onagrarieæ chiefly by its one-seeded cells, its pendent seeds, and its embryo furnished with a fleshy albumen.

HUNDRED AND FORTIETH FAMILY.

Onagrarieæ.—Juss.

Herbaceous vegetables, rarely frutescent, bearing simple leaves, opposite or scattered, and terminal or axillary flowers. Their calyx adheres to the inferior ovary, its limb having from four to five lobes. The corolla is formed of four to five petals, incumbent laterally, and twisted spirally before

their perfect expansion; this corolla is rarely wanting. The stamina are of the same number with, or double the petals; sometimes they are fewer. They are inserted on the tube of the calyx. The inferior ovary presents from four to five cells, containing a considerable number of ovules, attached to their inner angle. The style is simple, and the stigma is sometimes simple, sometimes of four or five lobes. The fruit is a berry or a capsule of four or five cells, often containing in each but a small number of seeds, and opening by as many valves, each of which bears one of the partitions on the middle of its inner surface. The seeds present a proper integument, usually formed of two layers, and immediately covering an homotropal embryo, destitute of albumen.

M. De Jussieu had placed in his family of the onagrarieæ a certain number of genera, which have been successively withdrawn from it. Thus the genus mocanera appears to us to belong to the family of the ternstræmiaceæ; cercodea forms the type of the family hygrobieæ. The genera cacoucia, combretum, belong to the combretaceæ; santalum forms the type of the santalaceæ; the genera mouriria and petaloma appear to us to belong to the melastomaceæ, and lastly, the genera loasa and mentzelia constitute the family of the loaseæ.

Among other genera we find in the onagrarieæ, epilobium, œnothera, lopezia, circœa, jussiæa, fuschia, &c. Very nearly allied to the myrtaceæ and melastomaceæ, the family of the onagrarieæ is distinguished from the former by its leaves with-

out dots, its stamina of a determinate number, and its port; from the melastomaceæ by the different structure of their leaves and their anthers.

HUNDRED AND FORTY-FIRST FAMILY.

Combretaceæ.—R. Brown. *Elæagnorum et Terminaliarum genera.*—Juss.

These are trees or shrubs with opposite or alternate leaves, entire or without stipules, bearing hermaphrodite or polygamous flowers, variously disposed in axillary or terminal spikes; their calyx adheres by its base to the ovary, which is inferior. Its limb, which is often tubular, is of four or five divisions, and jointed with the top of the ovary. The corolla is wanting in several genera, or composed of four to five petals, inserted between the lobes of the calyx. The number of stamina is in general double the divisions of the calyx; but this number is not strictly determinate. The ovary has but one cell, containing from two to four ovules, pendent from its summit. The style is more or less elongated, terminating in a simple stigma. The fruit is always one-celled, one-seeded by abortion and indehiscent. The seed, which is pendent, is composed of an episperm, immediately covering the embryo.

The combretaceæ are composed of genera formerly distributed, some among the elæagneæ, and others in the onagrarieæ.

Such are bucida, terminalia, conocarpus, quisqualis, combretum, &c. This family, at first view, does not appear to combine genera which have a close affinity to each other. In fact, some have petals and others want them; some have flat cotyledons, others have them rolled up. But the really distinctive character of this family consists in its one celled ovary, containing from two to four ovules pendent from the top of the cell, without a podosperm. By its apetalous genera, this family is connected with the santalaceæ, which are chiefly distinguished from it by the presence of an albumen, and by their erect ovules. By its petalous genera it is very much a-kin to the onagrarieæ and myrtaceæ, between which it ought to be placed.

HUNDRED AND FORTY-SECOND FAMILY.

Myrtaceæ.—Juss.

This interesting family is composed of trees or shrubs of an elegant port, whose different parts are full of a resinous, odorous juice. The leaves are opposite, entire, often persistent, marked with translucid points; the flowers are variously disposed, either in the axilla of the leaves or at the top of the branches. The calyx is monosepalous, adhering by its base to the inferior ovary, having its limb of five, six, or only of four divisions; the corolla, which is rarely wanting, is formed of as many petals as there are lobes in the calyx. The stamina, generally very numerous, rarely of a determinate number, have their filaments free or variously united, and their anthers terminal and generally rather small. The inferior ovary pre-

sents from two to six cells, which contain a variable number of ovules, attached to their inner angle. The style is generally simple, and the stigma lobed. The fruit presents a great many modifications; it is sometimes dry, dehiscent into as many valves as there are cells, sometimes indehiscent or fleshy. The seeds, generally destitute of albumen, have an embryo whose lobes are never convolute or rolled up in the shape of a paper cone.

Professor De Candolle has divided the family of the myrtaceæ into five natural tribes, which are:

1st. The chamælaucieæ; fruit dry, one-celled, seeds basilar; calyx five lobed; corolla of five petals sometimes wanting; stamina free or polyadelphous. The genera which form this tribe are all natives of New Holland; calytrix, chamælaucium, pileanthus, &c.

2d. The leptospermeæ; fruit dry, dehiscent, of many-cells; seeds attached to the inner angle, destitute of arillus and albumen; leaves opposite or alternate. Shrubs, all natives of New Holland: beaufortia, calotamnus, tristania, melaleuca, eudesmia, eucalyptus, metrosyderos, leptospermum, &c.

3d. Myrteæ: fruit fleshy, generally of many cells; seeds without arillus or albumen; stamina free; leaves opposite. Shrubs almost all natives of the tropics: eugenia, iambosa, calyptranthes, caryophyllus, myrtus, campomanesia, &c.

4th. The barringtonieæ: fruit dry or fleshy, always indehiscent, of many cells; stamina monadelphous at the base; leaves alternate, not dotted. Trees of the equinoctial regions of the old and new continent; dicalyx, stravadium, barringtonia, gustavia.

5th. Lecythideæ: fruit dry, opening by a lid; stamina very

numerous, monadelphous; leaves alternate without dots. Large trees of equinoctial America: lecythis, couratari, couroupita, bertholetia.

The family of the myrtaceæ, considered in its whole, forms a very distinct family among the dicotyledonous plants with an inferior ovary. It is allied to the melastomaceæ, which differ from it by the remarkable and constant disposition of the nerves of their leaves, and by the number and structure of their stamina; to the onagrarieæ, which are distinguished from it by their stamina of a determinate number; to the rosaceæ and combretaceæ, whose alternate leaves and multiple styles in the first, and embryo with rolled cotyledons in the second of these families, form their distinctive characters.

Translator's Note.—Almost all these vegetables are astringent, and many of them are aromatic stimulants. The former quality resides in tannin and gallic acid, which are contained in their barks, roots, leaves, flowers and fruits; and the latter in an essential oil which is found in small vesicles in the bark, leaves, petals, fruits, &c. The species employed in medicine on account of their essential oil, are the eugenia caryophyllata, which produces cloves, the myrtus pimenta, whose fruit is called allspice, and the melaleuca leucadendron, which yields cajeput oil. The flowers of the pomegranate have been employed in medicine for their astringency, particularly in the treatment of chronic diarrhœa. The bark of its root and its pericarp have the same qualities, and decoctions of them are considered as specifics for the cure of the tape worm. It contains little or no essential oil. The pulp of the fruit has an agreeably acidulous taste, by which it is well adapted for quenching thirst. For this quality it is highly prized in the warm climates of which it is a native. The fruit of the American guava (psidium) is highly esteemed for similar purposes.

The eucalyptus resinifera yields an extract which resembles kino and is employed in medicine for the same purposes.

Some of the other species of eucalyptus have been used in tanning.

HUNDRED AND FORTY-THIRD FAMILY.

Melastomaceæ.—Juss.

The melastomaceæ are large trees, shrubs or herbaceous plants, having opposite simple leaves, usually furnished with three to five, and sometimes even eleven longitudinal nerves, from which a great number of other transverse and parallel nerves arise, which are very close to each other. The flowers, sometimes very large, appear to have all the modes of inflorescence. The calyx is monosepalous, more or less adherent to the ovary, which is inferior or half inferior; its limb is sometimes entire or toothed, or else it is of four or five divisions, which are more or less deep; more rarely it forms a kind of coif or lid. The corolla is composed of four to five petals; the stamina are double that number. Their anthers have the most varied and most singular forms, and open at their top by an aperture or pore which is common to both the cells. The ovary is sometimes free; but oftener adherent to the calyx. It has from three to eight cells, each containing a great number of ovules. The top of the ovary is often covered with an epigynous disc. The style and stigma are simple. The fruit is sometimes dry and sometimes fleshy, hav-

ing the same number of cells as the ovary; it remains indehiscent or opens by as many valves, septiferous on their inner surface. The seeds are often reniform; they contain an erect or slightly curved embryo, but without albumen.

This family, which has been carefully studied by Professor De Candolle, in the third volume of his Prodrome, is very numerous in species, which have been grouped into a great number of genera. Among these genera there occur the following: melastoma, rhexia, miconia, tristemma, topobæa, &c. It is so distinct by the disposition of the nerves of its leaves, that it cannot be confounded with any other of those which it resembles; such as the onagrarieæ, the myrtaceæ and rosaceæ.

HUNDRED AND FORTY-FOURTH FAMILY.

Salicarieæ.—Juss.

Herbs or shrubs with opposite or alternate leaves, bearing axillary or terminal flowers, a monosepalous, urceolate, or tubular calyx, toothed at the top, a corolla of four to six petals, alternate with the divisions of the calyx, and inserted at the upper part of its tube; the corolla is wanting in some genera. The number of stamina is equal to or double the petals, more rarely of an indefinite number. The ovary is free, simple, of many cells, each containing a great number of ovules. The style is simple, terminated by a stigma, which is usually capitulated. The fruit is a capsule, covered by the calyx which is persistent, of one or more

cells, containing seeds attached to their inner angle. These seeds are composed of an embryo destitute of albumen.

Among the genera which compose this family we may mention the following: lythrum, cuphea, ginoria, lagæstræmia, ammania, &c. This family is allied to the onagrarieæ, from which it differs by its free ovary; to the rosaceæ; but these have always stipules, and a great number of other characters which distinguish them from the salicarieæ.

Translator's Note.—Several species of this family are possessed of astringency; the lythrum salicaria has been useful in the treatment of chronic dysentery.

HUNDRED AND FORTY-FIFTH FAMILY.

Tamariscineæ.—Desvaux.

Shrubs whose leaves are usually very small, scaly, and sheathing; flowers equally small, furnished with bracteas, and disposed in simple spikes, whose union sometimes forms a panicle. Their calyx is of four or five deep divisions; rarely it forms a tube at its lower part. Its divisions are imbricated laterally; the corolla is composed of four to five persistent petals; the stamina to the number of five, ten, or rarely four, are monadelphous at their base. The ovary is triangular, sometimes surrounded at its base by a perigynous disc; the style simple or tripartite. The fruit is a triangular capsule, of one cell, containing a con-

siderable number of seeds, attached to the middle of the inner surface of the three valves which form the capsule. The embryo is erect, destitute of albumen.

This little family is composed of the genus tamarix, which M. Desvaux, professor of botany at Angers, proposes to divide into two genera, namely, tamarix and myricaria. The genus tamarix formerly made a part of the family of the portulaceæ, from which it differs by its port and its embryo destitute of albumen. By the latter character the family of the tamariscineæ is related to the lythrarieæ.

HUNDRED AND FORTY-SIXTH FAMILY.

Rosaceæ.—Juss.

A large family composed of herbaceous vegetables, of shrubs or trees attaining to a very considerable size. Their leaves are alternate, simple or compound, accompanied at their base with two persistent stipules, sometimes united with the petiole. The flowers present different modes of inflorescence. They are composed of a monosepalous calyx of four or five divisions, sometimes accompanied externally with a kind of involucre, which adheres so intimately to the calyx, that it appears to have eight or ten lobes. The corolla, which is rarely wanting, is composed of four to five petals regularly spreading. The stamina are generally very numerous and distinct. The pistil presents several modifications; sometimes it is

formed of one or more carpels, entirely free and distinct, placed in a tubular calyx; sometimes the carpels adhere by their outer surface to the calyx; sometimes they are united, not only with the calyx but with each other; sometimes they are united into a kind of capitule on a receptacle or gynophorus. Each of these carpels is one-celled, and contains one, two, or a greater number of ovules, whose position is very various. The style is always more or less lateral, and the stigma simple. The fruit is exceedingly polymorphous; sometimes it is a true drupe, sometimes a melonida or apple, sometimes one or more achenuims or one or more dehiscent capsules, or lastly an union of small acheniums or little drupes, forming a capitule on a gynophorus, which becomes fleshy. The seeds have an homotropal embryo, destitute of albumen.

This great family has been divided into tribes, some of which have been considered by some authors as distinct families.

1st Tribe. Chrysobalaneæ, (R. Brown.) A single free ovary, containing two erect ovules; style filiform, growing nearly from the base of the ovary, flowers more or less irregular, fruit drupaceous, ex. Chysobalanus, parinarium, moquilea, &c.

2nd Tribe. Drupaceæ. D. C. A single free ovary, containing two collateral ovules, style filiform terminal, flowers regular; fruit drupaceous, ex. Prunus, amygdalus, cerasus, &c.

3rd Tribe. Spiraceæ, (Rich.) Several free ovaries or slightly united by their inner side, containing two or four collateral ovules; style terminal; capsules distinct, one-celled, or a single many-seeded capsule, ex. Spiræa, kerria.

4th Tribe. Fragariaceæ, (Rich.) Calyx spreading, often furnished with an external calicule; several one-seeded, indehiscent carpels on a fleshy gynophorus, style more or less lateral, ex. Potentilla, fragaria, geum, rubus, dryas, comarum, &c.

5th Tribe. Sanguisorbieæ, (J.) Flowers usually polygamous, and sometimes without a corolla; one or two carpels, sometimes adhering to the calyx, terminated by a style and stigma in the form of a feather or pencil. ex. Poterium, cliffortia, alchemilla, &c.

6th Tribe. Roseæ. (J.) Calyx tubular, urceolate, containing a variable number of one-seeded carpels, attached to the inner wall of the calyx, which becomes fleshy and covers them. ex. Rosa.

7th Tribe. Pomaceæ. (Rich.) Several one-celled carpels, each containing two ascending ovules, rarely a great number, attached to the inner side, united with each other and with the calyx, and forming a fleshy fruit, known by the name of melonida or apple. ex. Malus, pyrus, cratægus, sorbus, cydonia, &c.

Translator's Note.—All the rosaceæ are astringent, and particularly the tribe of the fragariaceæ. Their roots have been used in the treatment of dysentery, diarrhœa, and intermittents. The root of the tormentilla is employed for tanning in the Ferro Isles, and that of the capollim cherry in Mexico. The bark of the prunus virginiana is used as a febrifuge by the Americans. Besides astringency, the root of the gillenia trifoliata is also possessed of emetic powers, and is therefore used by the Americans as a substitute for ipecacuanha.

In the section of the pomaceæ, the young fruits, in addition to gallic acid and tannin, contain a considerable proportion of malic acid. They have therefore a sour, disagreeable taste; but as they advance to maturity the proportion of these principles is diminished, and they are partly converted into sugar. They are then fit for various purposes in domestic economy. The tribe of the drupaceæ are remarkable for containing in their

leaves, and particularly in their kernels, a large quantity of prussic acid. They also contain a volatile oil, which has the taste and smell of prussic acid, with which it also agrees in its effects on the animal economy. It is remarkable that this essential oil is composed of an azotized principle, incapable of crystallizing, which is poisonous, and of another which crystallizes, contains no nitrogen, and is perfectly inert.

Several species of this tribe yield a gum which has the properties of gum tragacanth, and may be employed for similar purposes. ex. The plum, the cherry, &c.

HUNDRED AND FORTY-SEVENTH FAMILY.

Homalineæ.—R. Brown.

The Homalineæ are shrubs or small trees, all natives of the warm parts of the globe. Their leaves are alternate, petioled, simple, furnished with caducous stipules. Their flowers are hermaphrodite, disposed in spikes, in racemes, or in panicles. Their calyx is monosepalous, having its tube short, conical, adhering to the ovary; its limb divided into a number of lobes, varying from ten to thirty, of which the outer are larger and valvar, the inner, smaller and in the form of petals. At the inner surface, and in general towards the base of the inner sepals, are situated glandular and sessile appendages. The number of stamina varies; it is sometimes equal to that of the outer lobes of the calyx, and the stamina are opposite to them. At other times the stamina are more númerous, and

united in bundles. The ovary is generally half inferior, of one cell, containing a great number of ovules attached to three or five parietal placentas. The styles, of the same number with the placentas, terminate each in a simple stigma. The fruit is sometimes dry, sometimes fleshy. The seeds have their embryo placed in a fleshy albumen.

A family as yet but little known, established by M. R. Brown, in his Memoir on the Plants of Congo, and adopted by M. De Candolle (Prodrome. Syst. 2. p. 53,) who places in it the following genera. Homalium, napimoga, pineda, blackwellia, astranthus, nisa, myriantheia, asteropeia, aristotelia. By the structure of its fruit, this family is related to the flacourtianeæ and the samydeæ, and by its insertion it ranks near the rosaceæ.

HUNDRED AND FORTY-EIGHTH FAMILY.

Samydeæ.—Vent.

All exotic shrubs, growing in the warmest regions of the globe, bearing alternate leaves in two opposite rows, simple, persistent, usually marked with translucid points, furnished with two stipules at their base. The flowers are axillary, solitary, or grouped. They have a calyx formed of five, more rarely of three to seven sepals, united together at their base, and sometimes forming a tube which is more or less elongated. The limb presents divisions, which are more or less deep, and coloured on their inner surface. The corolla

is always wanting. The number of stamina is equal, double, triple, or quadruple the divisions of the calyx, at whose base they are inserted; they are monadelphous, and some of them are occasionally barren and reduced to a filament, which becomes flat and pubescent. The ovary is free, of one cell, containing a great number of ovules inserted on three or five parietal placentas. The style is simple, terminated by a capitulated or lobed stigma. The fruit is a one-celled capsule, opening by three or five valves, which bear the seeds on the middle of their inner surface, enveloped in a more or less abundant and coloured pulp. The seeds have a fleshy albumen, in which is a very small embryo, which is heterotropal, that is having its radicle opposite to the hilum or point of attachment of the seed.

This family is composed of the genera samyda, anavringa, and casearia. By the structure of its fruit it approaches to the violarieæ and flacourtianeæ; but its insertion, evidently perigynous, places it near the rosaceæ, many of whose genera are also apetalous. Besides the three genera mentioned above, we may also refer to this family, the genus piparea of Aublet, heretofore placed among the violareæ.

HUNDRED AND FORTY-NINTH FAMILY.

Leguminosæ.—Juss.

A very natural family, in which are combined herbaceous plants, shrubs, small trees, and even

large ones of colossal dimensions. Their leaves are alternate, compound or decompound, sometimes simple; rarely the leaflets are abortive, and nothing remains but the petiole, which expands and forms a kind of simple leaf. At the base of each, there are often two persistent stipules. The flowers present a very varied inflorescence. They are in general hermaphrodite. Their calyx is sometimes tubular, of five unequal teeth, sometimes of five divisions, more or less deep and unequal. On the outside of the calyx are found one or more bracteæ, or sometimes an involucre of the shape of a calyx. The corolla, which is sometimes wanting, is composed of five petals usually unequal; of these the upper, which is the largest, encloses the others, and is called the standard; the two lateral are called wings, and the two lower are more or less united together, and form the keel; sometimes the corolla is formed of five equal petals. The number of stamina is generally ten, sometimes they are more; usually their filaments are diadelphous, rarely monadelphous, or entirely free, perigynous or hypogynous. The ovary is more or less stipitated at its base. It is in general oblong, inequilateral, one-celled, containing one or more ovules attached to the inner suture. The style is somewhat lateral, often recurved and terminating in a

simple stigma. The fruit is always a legumen. The seeds are in general destitute of albumen.

This large family is composed of a very considerable number of genera, which may be divided into three natural tribes, to wit:

1st. The papilionaceæ, which have a corolla formed of five unequal petals, forming the irregular corolla named papilionaceous; ten stamina usually diadelphous. Ex. phaseolus, faba, lathyrus, robinia, glycine, astragalus, phaca, &c.

2d. The cassieæ, whose corolla is in general formed of five regular petals; the ten stamina in general free. Ex. cassia, bauhinia, geoffræa, &c.

3d. The mimoseæ, containing the apetalous genera, furnished with an involucre in the shape of a calyx; stamina very numerous and free. Ex. mimosa, acacia, inga, &c.

The family of the leguminosæ is very nearly allied to the rosaceæ, and although at first it may appear very easy to distinguish them, yet it must be admitted, that there are some genera which serve in some respect as a connecting link between the two.

Translator's Note.—Although this family is very natural, yet it exhibits less uniformity in its properties than perhaps any other of the vegetable kingdom.

Several species are possessed of a purgative property in many of their organs. Of this we have examples in the leaves and fruits of cassia obovata, c. acutifolia, and c. lanceolata, which form the senna of commerce. The leaves of c. marylandica are employed in the United States as a substitute for senna, and those of several other species of this family in different parts of the world. The pulp contained in the pods of the cassia fistula, ceratonia siliqua, and tamarindus indica, is possessed of similar qualities. The barks of several species of

galega and of piscidia are used by the Americans as a fish poison. Its effects are similar to those of cocculus indicus.

De Candolle considers that the seeds of the leguminosæ are fit to be eaten when they contain but a small quantity of extractive in proportion to their fecula, as is the case in the common pea, bean, &c. These seeds are also distinguished by their cotyledons, which are very thick, have no cortical pores, and do not become leaves during germination, while the cotydons of such as are poisonous, or not eatable, are very thin, possessed of cortical pores, and changed in germination into seminal leaves. To the latter class belong the laburnum, whose seeds are emetic, the anagyris fœtida, and several species of coronilla which are purgative.

Many of the plants which belong to this family are remarkable for their astringency, such as the acacia catechu, the pterocarpus draco, which yields dragon's blood and p. erinacea, which produces a substance similar to kino. The logwood (hæmatoxylon campechianum,) is another example of it. On the contrary, many of them abound with mucilage, such as the acacia vera, a. arabica, a senegalensis, which yield common gum, and astragalus verus and creticus, from which is obtained the gum tragacanth.

Many of the species are rich in colouring matter. Of this we have examples in the species of indigofera, cæsalpinia, hæmatoxylon, pterocarpus, &c.

Some of them are aromatic stimulants, as containing a quantity of essential oil, resin, and sometimes benzoic acid. Thus the myroxylon balsamiferum yields the balsams of Tolu and Peru, and the dipterix odorata produces the Tonquin bean, whose perfume is derived from benzoic acid. Balsam copaiba is the product of the copaifera officinalis. Some are sweet, as the glycirrhiza glabra, some bitter, and used as a cure for intermittents and for worms, as the geoffroya inermis, and lastly, the seeds of a few species are distinguished for containing a fixed oil, as the guilandina moringa, which produces the oil of ben.

HUNDRED AND FIFTIETH FAMILY.

Terebinthaceæ.—Juss.

Trees or shrubs often milky or resinous, having alternate leaves, generally compound, without stipules; hermaphrodite or unisexual flowers, small, and generally disposed in racemes. Each of them presents a calyx of three to five sepals, sometimes united together at the base, and adhering to the ovary, which is inferior; a corolla, which is sometimes wanting, and is composed of a number of petals equal to the lobes of the calyx, and regular. The stamina are, in general, equal in number, more rarely double or quadruple the petals; in the first case they are alternate with the petals. The pistil is composed of three to five carpels, sometimes distinct, sometimes more or less united together, surrounded at their base by a perigynous, annular disc: occasionally some of the carpels prove abortive, and there remains but one, which bears several styles. Each carpel has but one cell, sometimes containing an ovule, borne on the top of a filiform podosperm, which grows from the bottom of the cell, sometimes a reversed ovule, sometimes two ovules either reversed or collateral. The fruit is dry or drupaceous, generally containing a single seed. The latter contains an embryo destitute of albumen.

This family has been the object of an excellent work by our excellent friend Professor Kunth. It may be divided into seven natural tribes:

1st. The anacardieæ or cassuvieæ, containing the genera anacardium, mangifera, pistacia, &c. 2d. The sumachineæ, where we find the genera rhus, mauria, duvaua, &c. 3d. The spondiaceæ, which comprise the genera spondias and poupartia. 4th. The burseraceæ, in which are combined the genera icica, boswellia, bursera, canarium, &c. 5th. The amyrideæ, ex. amyris. 6th. Connaraceæ, ex. connarus, omphalobium, cnestis, &c. 7th. Juglandeæ, juglans, carya, &c.

This family is very nearly related to that of the leguminosæ, from which it is chiefly distinguished by the absence of stipules; it has moreover some affinity to the rhamneæ, which differ from it by their ovaries, always inferior, and their stamina opposite to the petals.

Translator's Note.—The terebinthaceæ, as their name denotes, abound with essential oil and resin, or with turpentine. These principles are contained chiefly in their leaves and barks. As examples of these properties we may mention pistacia terebinthus, which yields chian turpentine, p. lentiscus, which produces mastich and the different species of amyris, from which are obtained gum elemi, the balm of Gilead or of Mecca, and myrrh. The origin of the latter drug, however, which has been referred to the amyris kataff, is still doubtful. Olibanum is considered to be the product of boswellia serrata.

Many of the species are possessed of a high degree of astringency. Thus, the rhus coriaria is employed in tanning leather, and the bark of the rhus glabrum, from its astringency, has been used in the treatment of intermittents.

The kernel of the seed has very often a sweet and agreeable taste, as for example, in the pistacia and the cashew nut (anacardium occidentale,) whose pericarp contains an oily

liquid, which is excessively acrid, and communicates an indelible black stain to linen; but whose kernel, when fresh, has a delicious taste, and abounds with a sweetish milky juice.

The false Angustura bark is supposed by some to belong to brucea ferruginea, a species of this family, while others refer it to strychnos colubrina, a native of the East Indies.

The juice of the rhus vernix, which yields the true Japan varnish, is so acrid as to inflame and blister the parts of the skin with which it comes in contact. Some are so susceptible of its action, as to be affected by its emanations even at a considerable distance. The r. toxicodendron is capable of producing similar effects, but in a slighter degree.

HUNDRED AND FIFTY-FIRST FAMILY.

Rhamneæ.—R. Brown. *Rhamnorum, pars.*—Juss.

These are trees or shrubs with simple alternate leaves, very rarely opposite, furnished with two very small stipules, caducous or persistent and spinous. The flowers are small hermaphrodite or unisexual, axillary, solitary, or united in a sertule, in fasciculi, &c., sometimes forming racemes, or terminal capitules. Their calyx is monosepalous, more or less tubular at its lower part, where it adheres to the ovary, which is inferior, having a widened limb of four or five valvar lobes. The corolla is composed of four or five petals with claws, very small, often rolled and concave; the stamina of the same number with the petals, are

placed opposite to them, and are often embraced by them. The ovary is sometimes free, sometimes half inferior, or completely adherent, of two, three or four cells, each containing a single, erect ovule. From the top of the ovary there arise in general as many styles as there are cells. The base of the tube of the calyx, when the ovary is free, and the top of the latter, when it is inferior, present a glandular disc, which is more or less thickened. The fruit is fleshy and indehiscent, or dry and opens into three cells. The seed is erect, and contains, in a fleshy albumen, sometimes very thin, an homotrope embryo, having its cotyledons very large and very thin.

The family of the rhamneæ, such as it had been established by the celebrated author of the Genera Plantarum, had been divided into four sections. Mr. R. Brown first proposed to form of the two first sections a distinct family under the name of celastrineæ. This family is chiefly distinguished by its calyx, whose lobes are imbricated and not valvar, by its stamina alternate and not opposite to the petals, and by its ovary always free, and whose cells contain one or two ovules, which are lateral, and placed the one above the other; by its fruit, always dry and opening by valves septiferous on the middle of their inner surface.

Mr. R. Brown has, moreover, proposed to make a distinct family, whose type shall be the genus brunia. This division of the family has been adopted by M. De Candolle in the second volume of his Prodrome, and by M. Brongniart the younger in his Dissertation on the Family of the Rhamneæ. Among the

genera of the rhamneæ we may here mention the following: rhamnus, paliurus, ceanothus, colletia, &c.

Translator's Note.—The fruits of the rhamnus catharticus are purgative. Those of the r. frangula and of the other species, have the same property, but they are chiefly used in dying either green or yellow. The barks of many of the species, such as Ceanothus Americanus, prinos verticillatus, are very bitter, tonic, and sometimes astringent. They are substituted for cinchona in the United States of America. The fruits of the jujube tree (zizyphus vulgaris) instead of being purgative, are mucilaginous and nutritive. They are, therefore, an exception to the general rule.

HUNDRED AND FIFTY-SECOND FAMILY.

Celastrineæ.—R. Brown. Ad. Brong. *Rhamnorum, pars.*—Juss.

This family is composed of shrubs or small trees with alternate leaves, or sometimes opposite, and with axillary flowers disposed in cymes. The calyx, slightly tubular at its base, presents a limb of four or five spreading divisions, imbricated before expansion. The corolla is composed of four to five flat petals, slightly fleshy, without a claw, inserted under the disc. The stamina, alternate with the petals, are inserted either on the edge of the disc, or on its upper surface. The disc is perigynous and parietal, surrounding the ovary. The latter is of three or four cells, each containing one or more seeds attached by a filiform podos-

perm to the inner angle of each cell, and ascending. The fruit, which is sometimes a dry drupe, is oftener a capsule of three or four cells, opening by three or four valves, each of which bears a partition on the middle of its inner surface. The seeds, sometimes covered by a fleshy arillus, contain a fleshy albumen, in which is an axile and homotrope embryo.

In speaking of the rhamneæ, we have pointed out the chief differences between that family and the celastrineæ. M. De Candolle, in his Prodrome, divides the latter family into three tribes, to wit, the staphyleaceæ, the euonymeæ, and the aquifoliaceæ. M. Adol. Brongniart adopts the first opinion of the celebrated professor of Geneva, who in his elementary theory had considered the aquifoliaceæ as a distinct family. In fact, this group is distinguished from the true celastrineæ, by its corolla, which is often monopetalous, its hypogynous insertion, the complete absence of a disc; the cells of its ovary always containing a single pendent ovule; its fleshy fruit, containing from two to six bony nucules.

Translator's Note.—The fruit and inner bark of the euonymus are purgative, and in large doses emetic.

HUNDRED AND FIFTY-THIRD FAMILY.

Aquifoliaceæ.—D. C. *Ilicineæ.*—Ad. Brong.

Small trees with alternate or opposite leaves, coriaceous, persistent, glabrous, with teeth sometimes spinous, having their flowers solitary or variously grouped in the axilla of the leaves. Each

of them has a calyx of four to six sepals, small and imbricated ; a corolla of an equal number of alternate petals, united together by their base, and forming a monopetalous corolla, with deep, hypogynous divisions. The stamina, alternate with the lobes of the corolla, are inserted at its base ; there is no trace of a disc. The ovary is free, thick, truncated, having from two to six cells, each of which contains a single ovule pendent from the top of the cell, and borne upon a cup-shaped podosperm ; the stigma is in general sessile and lobed. The fruit is always fleshy, containing from two to six indehiscent nucules, woody or fibrous, and one-seeded. The embryo is small, homotropal, and placed twards the base of a fleshy albumen.

This family, as we have shewn in speaking of the celastrineæ, is very distinct from the true rhamneæ and celastrineæ with which it had been united. These differences are even so great, that M. De Jussieu, and more lately Professor De Candolle, thought they might place the aquifoliaceæ among the monopetalous plants, near the sapotaceæ, and particularly the ebenaceæ from which they differ only by unimportant characters. But M. De Candolle has since abandoned this opinion, since in the second volume of his Prodrome, he makes the aquifoliaceæ a simple tribe of the celastrineæ. However, the first opinion appears to us to be the more correct. Among the genera which compose the aquifoliaceæ we find the following, cassine, myginda, &c.

Translator's Note.—The Paraguay tea is the foliage of the ilex vomitoria. Its leaves are used by the North American

Indians as an emetic; they also infuse them as a tea, in order to produce a slight intoxication when they are preparing for battle.

A decotion of the leaves of the ilex aquifolium is very bitter, and taken internally will excite perspiration. It has been used in the treatment of gout and rheumatism, and by some it has been recommended as a cure for intermittents.

FIFTEENTH CLASS.

DICLINY.

HUNDRED AND FIFTY-FOURTH FAMILY.

Euphorbiaceæ.—Juss.

The euphorbiaceæ are herbs, shrubs, or very large trees, which generally grow in all parts of the globe. The greater part of them contain a milky, very acrid juice; the leaves, usually alternate, are sometimes opposite, accompanied with stipules, which are sometimes wanting. The flowers are unisexual, generally small, and they present a very variable inflorescence. Their calyx is monosepalous, of three, four, five, or six deep divisions, furnished on the inside with scaly and glandular appendages. The corolla is wanting in the greater number of the genera, or is composed of petals, sometimes distinct, sometimes united into a monosepalous corolla. But this corolla appears to be formed only of abortive and barren sta-

mina. In the male flowers there is reckoned a considerable number of stamina; more rarely the number is limited, or even each stamen may be considered as a flower (as is admitted to be the case in the genus euphorbia.) These stamina are free or monadelphous. The female flowers are composed of a free ovary, sessile or stipitated, sometimes accompanied with an hypogynous disc. The ovary is in general three-celled, each cell containing one or two suspended ovules. From the top of the ovary arise three stigmas, generally sessile and oblong. The fruit is dry or slightly fleshy. It is composed of as many carpels containing one or two seeds, as there are cells in the fruit. These carpels, which are bony within, open elastically by their inner angle into two valves. By their inner angle they rest upon a central column, which is often persistent after their dispersion. Their seeds, which are crustaceous externally, and present a small fleshy caruncle near their point of attachment, have a fleshy albumen, in which is contained an axile and homotropal embryo.

We are indebted to M. Adrien De Jussieu for an excellent monograph on the genera of this family, whose number amounts to eighty-six, containing nearly a thousand and forty species. Among these genera, it will be sufficient here to mention the following: euphorbia, mercurialis, ricinus, cróton, iatropha, hura, buxus, acalypha, &c.

The family of the euphorbiaceæ is extremely distinct by the structure of its fruit. It has affinities to some of the terebinthaceæ and rhamneæ.

Translator's Note.—The acrimony of these vegetables resides in the milky juice with which most of them abound. This contains resin and an acrid volatile principle, which is dissipated by heat.

The products of the euphorbiaceæ have been employed for various purposes in medicine and the arts. Thus the roots of several species of euphorbia and particularly of E. ipecacuanha, have been used as emetics, and the juices of most of them will act as a drastic purgative, taken internally, or as a blister when applied to the surface. The same quality exists in their seeds. But here it is interesting to remark, that the embryo alone is purgative, the albumen being comparatively mild and almost eatable. This statement is made on the authority of Jussieu, who particularly examined the seeds of the ricinus communis, and says it is equally true of the seeds of all the species; but Guibort thinks, that the excess of acrimony in the embryo of the castor oil seed is very trifling. It is said that the oil can be rendered perfectly mild by exposure to heat, by which the acrid principle is dissipated, or by treating it with sulphuric acid. Cassava is obtained by a similar process, from the roots of the iatropha manihot, which, in the crude state, are extremely poisonous, but by roasting and washing become perfectly mild and nutritive.

The pigment called turnsol is prepared from the tops of the croton tinctorium. It is used for dying silk and wool of a beautiful blue colour, and communicates a similar colour to the strong blue paper which covers lump sugar. A similar dye might be prepared from many of the other species of this family.

The euphorbiaceæ abound with caoutchouc, which may be readily obtained from many of them. The juice of the

sapium aucuparium is so viscid, as to be used for birdlime by the Americans.

HUNDRED AND FIFTY-FIFTH FAMILY.

Urticeæ.—Kunth. *Urticeæ.*—Juss. *And Celtideæ.*—Rich.

Herbaceous plants, small trees or large trees, sometimes lactescent, with alternate leaves, in general furnished with stipules; having unisexual flowers, very rarely hermaphrodite, solitary or variously grouped, and forming catkins, or united in a fleshy involucre, flat and spreading, or pear-shaped and closed. In the male flowers there is found a calyx formed of four to five sepals, either distinct or united, and forming a tube; four to five alternate stamina, or very rarely opposite to the sepals. The female flowers have a calyx formed of two to four sepals, or a simple scale in the axilla of which they are placed. The ovary is free, of one cell, containing a single pendent ovule, and surmounted either by two long sessile stigmas, or by a single stigma supported sometimes on a style of variable length. The fruit is always composed of a crustaceous achenium, enveloped by the calyx, which sometimes becomes fleshy; at other times the involucre, which contained the female flowers becomes enlarged, as is observed in the fig, dorstenia, &c. The seed,

besides its proper integument, is composed of an embryo, in general recurved, often contained in the interior of a rather thin albumen.

After the example of our learned friend Professor Kunth, we have added to the urticeæ, the genera ulmus and celtis, formerly placed among the amentaceæ, and formed into a family by the name of celtideæ. In fact the latter group differs in no essential character from the other urticeæ. This family, thus limited, may be divided into three tribes in the following manner:

1st. Celtideæ (Rich.) flowers hermaphrodite, embryo without albumen. Ex. ulmus, celtis.

2d. True urticeæ: flowers unisexual, fruit distinct, embryo contained in a thin albumen. Ex. urtica, parictaria, humulus, cannabis, morus.

3d. Artocarpeæ (D. C.) flowers unisexual, fruit united in a fleshy involucre, flat or pyriform, embryo furnished with an albumen. Ex. dorstenia, ficus, &c.

Translator's Note.—The artocarpeæ abound with a milky juice, which resembles that of the euphorbiaceæ, in containing a certain quantity of caoutchouc. Their juice is acrid, caustic, and powerfully stimulant, and in some it is highly poisonous. The antiaris toxicaria yields the Japanese poison called upas antiar. The roots of the plants belonging to this section are possessed of very active properties. Of this we have an example in the roots of the dorstenia contrayerva, which are bitter, aromatic, and stimulant. The roots of the other species are according to the dose, either emetic or purgative. But yet the fruits of the whole of this section may be safely eaten when ripe, and some of them are highly nutritive. That of the bread fruit tree (artocarpus incisa,) which is sometimes as large as a child's head, and the common fig, may be

quoted as examples of their utility in furnishing articles of food.

The humulus and cannabis agree with each other, in containing a narcotic, bitter principle, and with the rest of this family in the nature of their inner bark, which is very tenacious, and capable of being manufactured into cloth and cordage.

HUNDRED AND FIFTY-SIXTH FAMILY.

Monimieæ.—Juss. *Atherospermeæ.*—R. Brown.

Large or small trees, with opposite leaves, destitute of stipules, and with unisexual flowers. These flowers present a globular or cup-shaped involucre, whose divisions are disposed in two rows; in the first case, this involucre presents only a few small teeth at its summit, and in the male flowers, it bursts and opens into four deep lobes, which are rather regular; the whole of the upper surface is covered with stamina, having short filaments, each of them constituting a male flower. In the second case (ruizia,) the stamina only line the lower and tubular part of the involucre, the filaments are larger, and towards their lower part they bear on each side a pedi-celled tubercle, similar to that which is observed on the same part in the laurineæ. The female flowers are composed of an involucre perfectly similar to that of the male flowers. In the genera monimia and ruizia, there are found at the bottom of this

involucre, from eight to ten erect pistils, quite distinct from each other and intermixed with hairs. In Ambora these pistils are very numerous, wholly immersed in the thickness of the walls of the involucre, having nothing free and visible but the summit, which is a small conical pap, and forms the true stigma. Each of these pistils is one-celled, and contains a single ovule pendent from its summit. In the genera ambora and monimia, the involucre is persistent; it even grows considerably, and becomes fleshy in the first of these genera. The fruit, which, in ambora, is imbedded in large numbers in the thickness of the walls of the involucre, is a small one-celled and one-seeded drupe. The seed is composed of a proper integument, rather thin, covering a very large fleshy albumen, in the upper part of which is placed an embryo, having the same direction with the seed.

This family, established by Jussieu, had been divided into two distinct families by R. Brown. But these two families, in our opinion, form only two tribes of the same natural order.

1st Tribe. Ambora, anthers opening by a longitudinal groove; seeds reversed: ambora, monimia, ruizia.

2nd Tribe. Atherospermeæ. Anthers opening from the base to the top by the means of a valve; seeds erect; pavonia, atherosperma, citrosma.

The monimieæ are closely allied to the urticeæ, with which many of the genera that compose it were formerly united; but they chiefly differ from them by their seeds, which are furnished

with a very large albumen, and by their ovule, which is pendent and not erect. The same character also distinguishes them from the laurineæ, which they resemble by the structure of their stamina in the tribe of the atherospermeæ.

HUNDRED AND FIFTY-SEVENTH FAMILY.

Salicineæ.—Rich.

A family which is composed of two genera, salix and populus. They are large trees with alternate, simple leaves, furnished with caducous stipules. Their flowers are unisexual, and disposed in cylindrical or ovate catkins. The male flowers are composed of a number of stamina varying from two to twenty, placed in the axilla of a scale, or on its upper surface. The female flowers consist of a fusiform pistil, terminating in two bipartite stigmas, situated in the axilla of a scale, and sometimes accompanied at their base by a calyx in the shape of a cup. This ovary is of one or two cells, containing a considerable number of erect ovules, attached to the bottom of the cell and at the base of two parietal placentas. The fruit is a small oblong capsule of one or two cells, containing several seeds covered with long silky hairs, and opening by two valves. The embryo is erect homotropal, without albumen.

Formed at the expense of the family of the amentaceæ, the salicineæ constitute a group, which is very distinct by the structure of its fruit.

Translator's Note.—The barks of the salicineæ are very astringent, and may be employed in tanning or in the treatment of agues. The dose of the powdered willow bark is the same as that of cinchona. The salix caprea, s. alba, and s. fragilis are the species chiefly recommended for the latter purpose.

HUNDRED AND FIFTY-EIGHTH FAMILY.

Myriceæ.—Rich. *Casuarineæ.*—Mirbel.

If we except the genus casuarina, which, by its port, resembles a gigantic horsetail (equisetum,) the myriceæ are large or small trees with alternate or scattered leaves, with or without stipules. Their flowers are always unisexual and diœcious. The male flowers disposed in catkins are composed of one or more stamina, often united together upon a branched androphorus, and placed in the axilla of a bractea; the female flowers also in catkins are solitary and sessile in the axilla of a bractea longer than themselves. Each flower is composed of a lenticular ovary, containing a single erect ovule; the style, which is very short, is surmounted by two long oval-shaped and glandular stigmas. On the outside of the ovary there are found two, three, or a greater number of hypogynous and persistent scales, sometimes adhering to the fruit. The latter is a kind of small nut, one-seeded and indehiscent, membranous, and winged upon the edges. The seed which it contains is erect; its

integument immediately covers a large embryo, having a direction entirely opposite to that of the seed.

Composed of genera, formerly placed in the polymorphous group of the amentaceæ, this family is allied at once to the celtideæ and the betulineæ; but it differs from the former by its flowers in catkins, and always unisexual; by its erect ovule; from the latter, by its one-celled ovary, and its embryo without albumen.

HUNDRED AND FIFTY-NINTH FAMILY.

Betulineæ.—Rich.

Trees, with simple, alternate leaves, accompanied at their base with two stipules; flowers unisexual, disposed in scaly catkins. In the male catkins, each scale, which is sometimes formed of several scales united, bears two or three naked flowers, or having a calyx of three or four deep divisions. The number of stamina in each flower is very variable. The female catkins are ovate or cylindrical, scaly. At the inner base of each scale there are found, from one to three sessile flowers, naked, presenting a free ovary, composed of two cells, each containing a single ovule attached towards the upper part of the partition, and surmounted by two long stigmas, elongated, cylindrical and glandular. The fruit is a scaly cone, whose scales, either woody or simply cartilaginous,

bear one or two small acheniums at their base, which are one-celled, one-seeded by abortion, and membranous on their edges. Their seed is composed of a large embryo without albumen, having the radicle superior.

The two genera alnus and betula form this family, which differs from the salicineæ by its ovary of two one-seeded cells, its indehiscent fruits and its seeds destitute of the long hairs which cover those of the salicineæ. The Myriceæ have also some analogy to the betulineæ; but their ovary, always one-celled, and their erect ovule, are the characters which distinguish that family from the betulineæ.

TRANSLATOR'S NOTE.—The plants of this family agree with those of the salicineæ in their chemical composition and their effects on the animal economy.

HUNDRED AND SIXTIETH FAMILY.

Cupuliferæ.—RICH. *Amentacearum, gen.*—JUSS.

THESE are trees with alternate, simple leaves, furnished at their base with caducous stipules. Their flowers are always unisexual, and nearly always monœcious. The male flowers form cylindrical, scaly catkins. Each flower presents a simple scale, which is three lobed or shaped like a calyx, on whose upper surface are attached from six to a great number of stamina without any trace of a pistil. The female flowers are generally axillary, sometimes solitary, sometimes grouped

in capitules or in catkins. In all cases, each of them is either partially or wholly covered by a scaly cup, and presents an inferior ovary, whose limb projects but little, and forms a small, irregularly toothed border. From the top of the ovary springs a short style, which terminates in two or three awl-shaped or flat stigmas. This ovary presents two, three, or a greater number of cells, each containing one or two suspended ovules. The fruit is always a gland, generally one-celled, often one-seeded by abortion, always accompanied with a cup, which sometimes covers the entire fruit like a pericarp, as in the chesnut and beech. The seed is composed of a very large embryo destitute of albumen.

This family, composed of genera placed formerly in the old family of the amentaceæ, comprises the genera quercus, corylus, carpinus, castanea and fagus. It has some affinities to the coniferæ and betulineæ; but the former are sufficiently distinguished from it by their port, the structure of their female flowers, and their embryo furnished with albumen; the latter by their female flowers disposed in cones, their simple ovary, &c.

With respect to the other families which have been formed at the expense of the amentaceæ, such as the salicineæ, the myriceæ, their free ovary is the character by which they are best distinguished from the cupuliferæ.

Translator's Note.—There is great uniformity in the properties of the plants which belong to this family. Their barks abound with tannin and gallic acid, and their seeds, con-

sisting of fecula and fixed oil, are mild and nutritious. In many instances the fixed oil amounts to half the weight of the seed. That of the beech nut is remarkable for keeping very long before it becomes rancid. The gall is an excrescence on the bark of the quercus infectoria produced by the nest of an insect. The bark of the q. robur is, in this country, employed for tanning leather, and is used as an astringent in medicine.

HUNDRED AND SIXTY-FIRST FAMILY.

Coniferæ.—J. Rich.

This family is composed of all those arbuscles and trees which are related to the pine and the fir, and which are usually designated by the name of evergreen and resinous trees. Their leaves, coriaceous and stiff, are persistent in all the species, except the larch and the gingo. These leaves are sometimes linear, awl-shaped, united in numbers varying from two to five, and accompanied at their base with a small scarious sheath; or else they are in the form of imbricated and lanceolate scales. The flowers are always unisexual, and in general disposed in cones or catkins. Each of the female flowers consists essentially of a stamen which is sometimes naked, sometimes accompanied with a scale, in the axilla or on the under surface of which it is placed. Frequently several stamina are united together by their filaments, and their anthers, which are one-celled, remain distinct, or they are united. The inflorescence

of the female flowers is very variable, although in general they form scaly cones or catkins. Thus they are sometimes solitary, either terminal or axillary, or else they are united in a fleshy or dry involucre. Each of these flowers presents a monosepalous calyx, adhering to the ovary, which is wholly or partially inferior; its limb, sometimes tubular, is one time entire, at another time it consists of two spreading lobes, which are glandular on their inner surface, and which have been usually considered as two stigmas. The ovary is one-celled, containing a single ovule. At its summit it usually presents a small cicatrix, which is the true stigma. Sometimes these female flowers are erect in the axilla of the scales or in the involucre in which they are situated; sometimes they are reversed and united in pairs by one of their sides to the inner surface, and at the base of the scales that compose the cone. The fruit is generally a scaly cone or a galbulus, whose scales are sometimes fleshy, become united, and resemble a kind of berry, as, for example, in the juniper. Each fruit in particular, that is to say, each fecundated pistil, has a pericarp, often crustaceous, sometimes furnished with a membranous and marginal wing. The proper integument of the seed adheres to the pericarp and covers a nucleus composed of a fleshy albumen, containing an axile, cylindrical embryo, whose radicle is united to the albumen, and whose

cotyledonary extremity is divided into two, three, four, and up to ten cotyledons.

The family of the coniferæ, on which my father has published a beautiful work, (Commentatio Botanica de Coniferis in fol. fig. Paris, 1826,) may be divided into three orders;

1st. Taxineæ; female flowers distinct from each other, attached to a scale or in a cup. Fruit simple. Ex. podocarpus, dacrydium, taxus, salisburia, phyllocladus, ephedra.

2d. Cupressineæ; female flowers erect, united many together in the axilla of scales, which are few in number, forming a sometimes fleshy galbulus. Ex. juniperus, thuya, callitrix, cupressus, taxodium.

3d. Abiesineæ; here are united all the genera whose female flowers are reversed, and whose fruit is a true scaly cone. Ex. pinus, abies, cunninghamia, araucaria, &c.

Translator's Note.—The essential oil and resin with which the coniferæ abound, are extracted and applied to various purposes in medicine, the arts, and domestic economy. The products employed in medicine, are obtained from different species in different parts of the world. The greatest quantity of the turpentine and essential oil consumed in this country, are obtained from the pinus sylvestris, in France from the pinus maritima, and in North America from the p. palustris. This latter species yields the Boston turpentine; the American turpentine is extracted from the p. strobus.

To the genus abies we are indebted for many valuable products. The abies picea yields the Strasburgh turpentine, the abies balsamea, the Canadian balsam, and spruce beer is prepared from the young shoots of the two species nigra and alba. This and Burgundy pitch are products of the a. communis.

The larix communis yields the Venice turpentine, which is

chiefly used internally. It also produces the Briançon manna, and the gummi orenburgense, which has properties similar to those of gum arabic.

The different species of juniper have properties exactly similar to those of the genera which we have already considered; but they are chiefly used for the sake of their essential oil.

The seeds of the coniferæ yield a fixed oil which soon becomes rancid; those of the p. pinea resemble almonds in taste, but have a slight flavour of turpentine, and are eaten by rich and poor in the South of France and in Italy.

The dammar pine (agathis) yields a turpentine which is used by the inhabitants of Amboyna for healing ulcers. It is soft when it first flows from the tree; but in a few days it becomes as hard as a stone, and possesses the clearness and transparency of a crystal.

HUNDRED AND SIXTY-SECOND FAMILY.

Cycadeæ.—Richard.

The cycadeæ, composed of only two genera, cycas and zamia, are exotic vegetables having the port of palms. Their leaves united at the top of the stipe, are pinnate and circinated before expansion, as in the ferns. The flowers are always diœcious. The male flowers form catkins or cones, which are sometimes very large, composed of spathulate scales, which are covered on their under surface with a great number of stamina, each of which must be considered as a male flower. The inflorescence of the female flowers is not the same in the two genera cyas and zamia.

In the former, a long, spathuliform, acute, spadix, toothed on its sides, bears at each tooth a female flower, which is sunk in a small depression. Zamia also has its female flowers in a cone, and its scales, which are thick and peltate, bear each upon its under surface two female flowers reversed. These flowers are composed of a globular calyx, pierced with a very small opening at its top, and applied to the ovary to which it partially adheres at its base. This ovary is one-celled, and contains a single ovule ; it terminates at the top in a stigma which has the form of a nipple. The fruit is a kind of nut, formed by the calyx, which is sometimes in a slight degree fleshy. The pericarp is in general thin, crustaceous and indehiscent, adhering to the proper integument of the seed. The kernel is composed of a flesby albumen, containing an embryo with two unequal cotyledons, which sometimes cohere together and whose radicle is united to the albumen.

If we compare the structure of the male flowers, and particularly of the female flowers of the cycadeæ with that of the coniferæ, we shall be struck with the great resemblance between the two families, and we must adopt the opinion of my father, who places them the one beside other. In both, in fact, each of the male flowers consists of a single one celled anther ; the female flowers are composed of a monosepalous perianth, of a half inferior ovary, which is one-celled and contains but a single ovule. The fruit and the seed have the same organization in both. It is true that the port of the two fa-

milies is wholly different, since the cycadeæ perfectly resemble the palms, and the inner structure of their stem is that of the monocotyledons. But is it right to sacrifice to this character, the important analogies which exist between the flowers of the cycadeæ and coniferæ in regard to their organization? Are we to place among the monocotyledons, a family whose embryo is evidently possessed of two cotyledons? Or admitting that we are, with which of the monocotyledonous families are we to place it? It has no affinity to any of those families; they must, therefore, remain separated. But if the preference be given to the structure of the embryo and of the flowers, and that the cycadeæ are placed among the dicotyledons, there can be no doubt respecting the place which they ought to occupy. They naturally arrange themselves next to the coniferæ.

TRANSLATOR'S NOTE.—The cycas is cultivated in China and Japan chiefly for the sake of its pith, which yields sago, a substance upon which the native Indians live for three or four months in the year.

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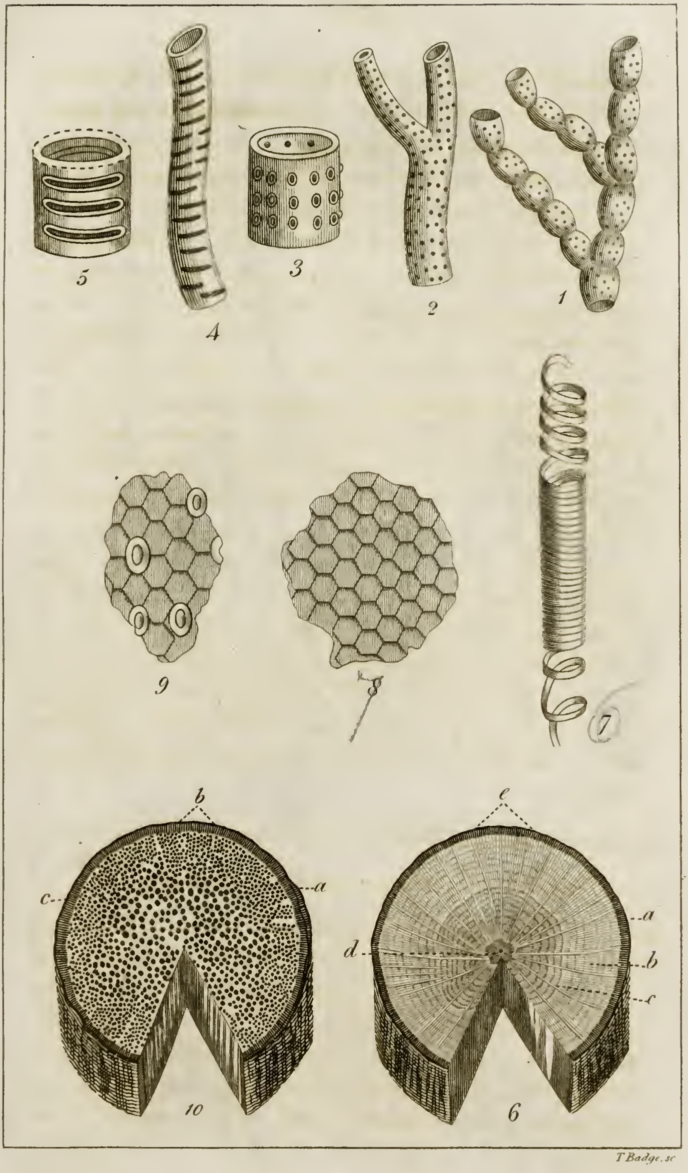

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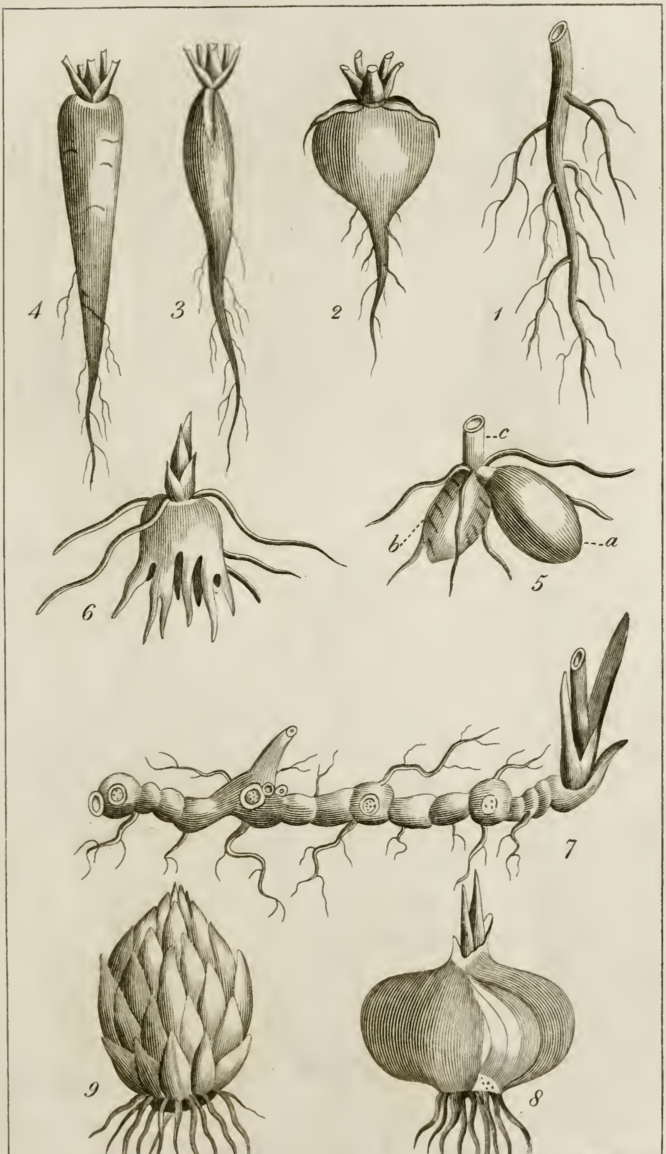
VEGETABLE ANATOMY.

Pl. 2.



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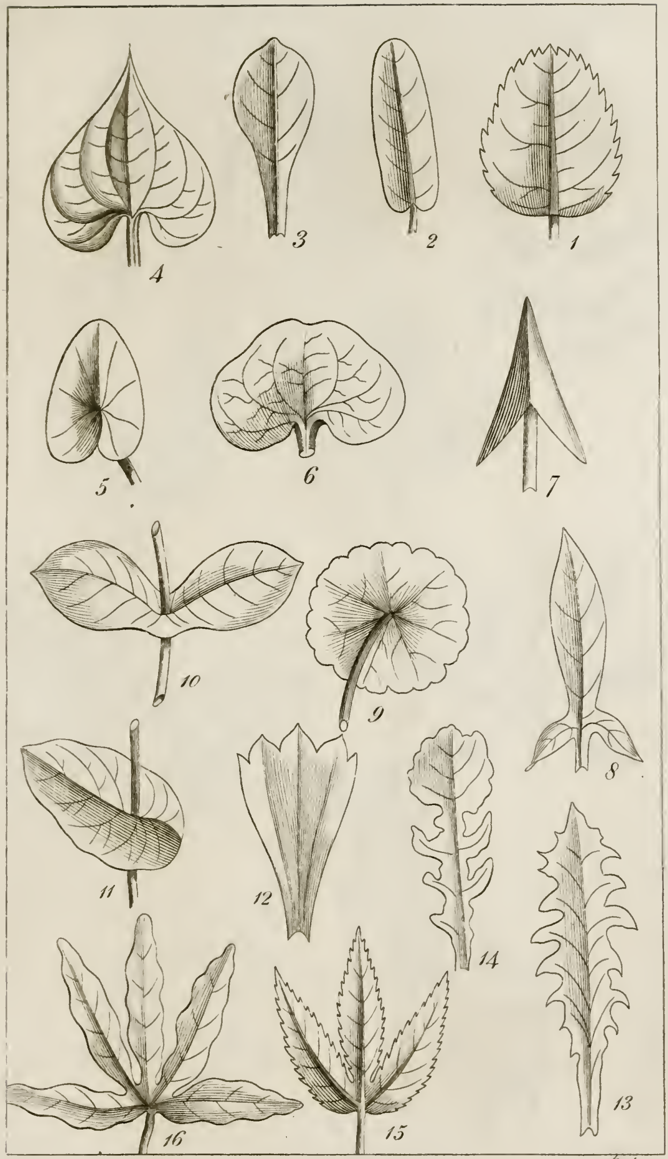
ROOTS, STOCK ROOT BULBS.

Pl. 3.



SIMPLE LEAVES.

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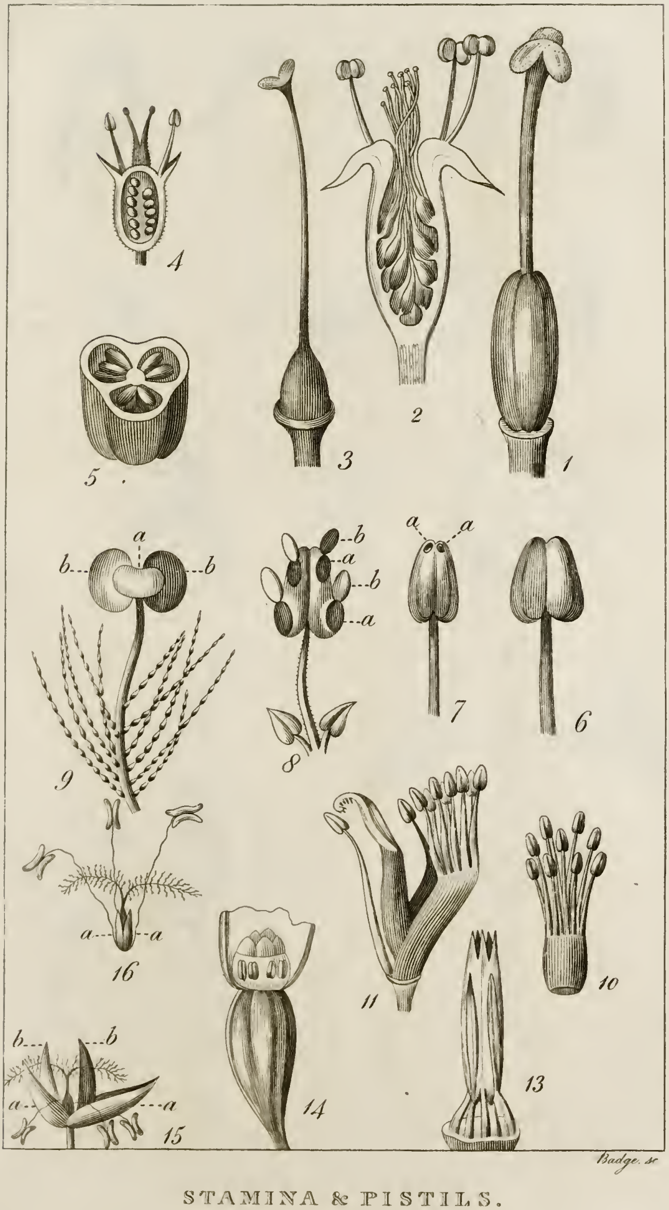
COMPOUND LEAVES.

FLOWERS.



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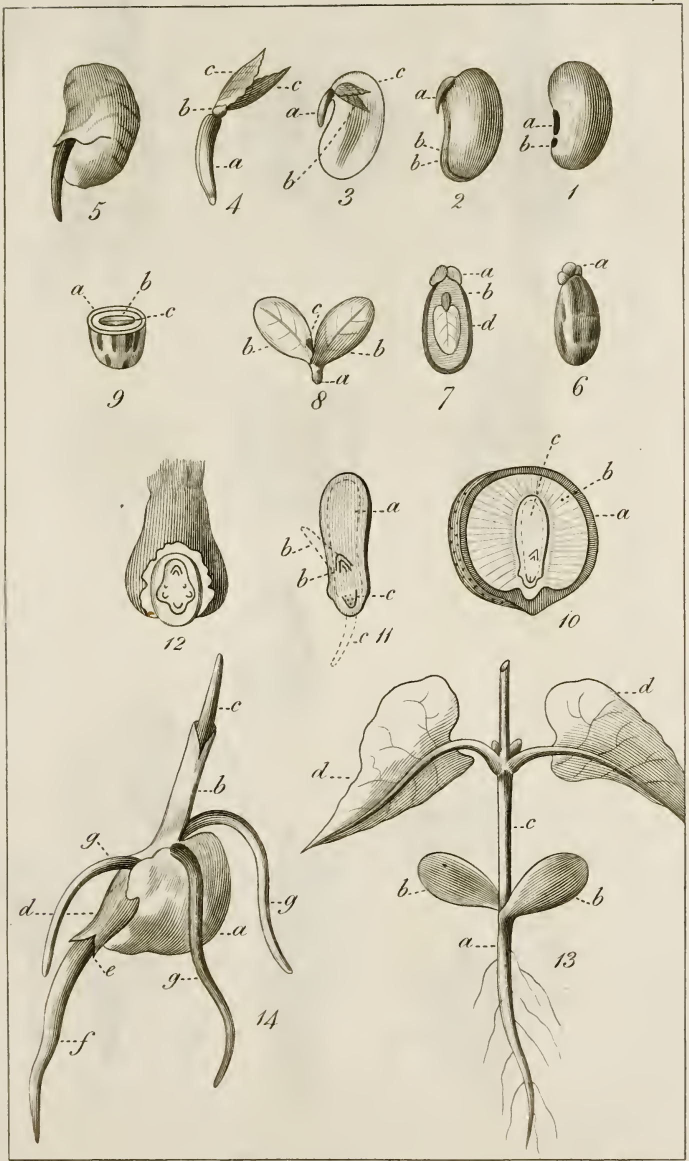
STAMINA & PISTILS.



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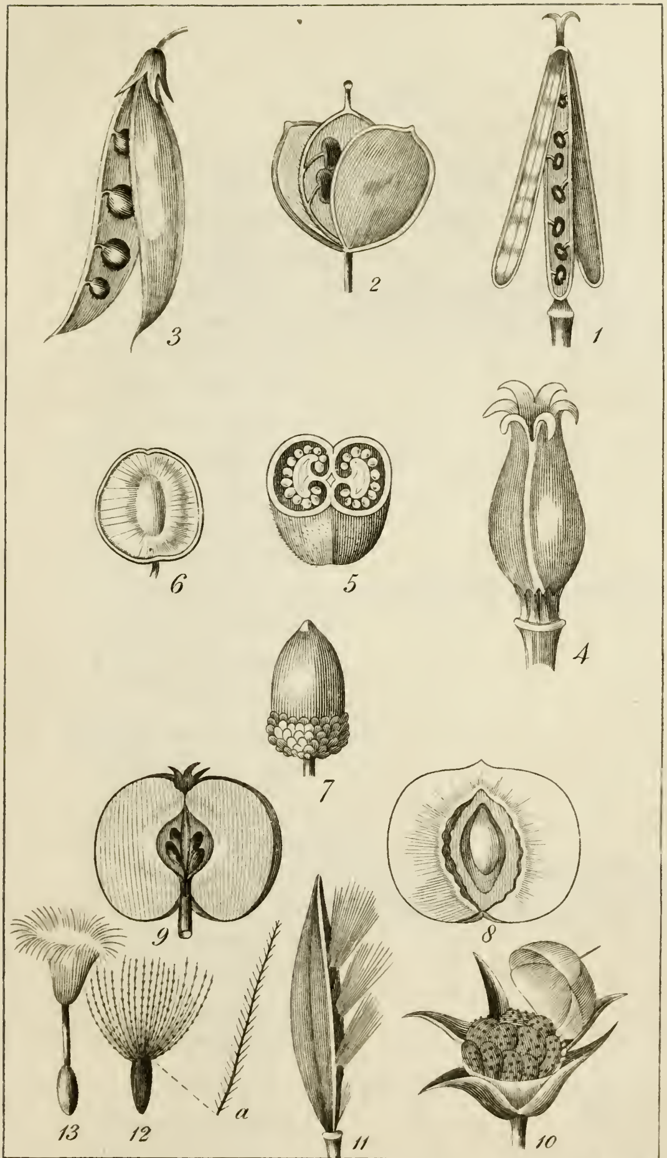
SEEDS & GERMINATION.

Pl. 8.



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FRUITS.

ALPHABETICAL TABLE

OF

THE FAMILIES OF PLANTS,

DESCRIBED IN THIS WORK.

EXPLANATION OF THE PLATES.

FIRST PLATE. Vegetable Anatomy.

Fig. 1. Moniliform, or beaded vessels.

Fig. 2. Porous vessels.

Fig. 3. A portion of a porous vessel magnified.

Fig. 4. A slit vessel, or false spiral.

Fig. 5. The same magnified.

Fig. 6. A portion of the trunk of a dicotyledonous tree composed of concentric layers; at *a* is seen the bark; at *b* the alburnum or false wood; at *c* the properly so called wood; at *d* the medullary canal.

Fig. 7. A spiral vessel or trachea.

Fig. 8. Regular cellular tissue.

Fig. 9. A portion of the epidermis to shew the cortical pores.

Fig. 10. A portion of the stipe of a monocotyledonous tree, formed of bundles of ligneous fibres, scattered in the midst of medullary substance.

SECOND PLATE. Roots, Stock, Bulb.

Fig. 1. A branched, perpendicular root.

Fig. 2. The root of the Rape (brassica napus.) It is perpendicular, simple, and napiform.

Fig. 3. The root of a variety of the former. It is simple, fleshy, *fusiform*, and perpendicular.

Fig. 4. The root of the Carrot, (daucus carota.) It is simple, fleshy, perpendicular, *conical*.

Fig. 5. Tuberiferous root, (orchis militaris.) It is twin, with ovate, entire tubercles; *a* is the tubercle which is to produce the new stem; *b* is that which has produced the old.

Fig. 6. The tuberiform root, (orchis maculata,) with palmate tubercles.

Fig. 7. The stock root, rhizoma, or subterraneous stem of Solomon's Seal (polygonatum vulgare.) At regular distances may be seen the circular marks arising from the shoots of former years. This species of stem is that which has received the name of progressive, sigillated, or premorsed root. It is a true stem, and not properly speaking a root.

Fig. 8. The tunicated bulb of the common Onion, (Allium Cepa.)

Fig. 9. The scaly bulb of the Lily, (Lilium candidum.) It is composed of fleshy scales which are imbricated like the tiles of a house.

THIRD PLATE. Simple Leaves.

Fig. 1. Leaflet of the Rose, (Rosa centifolia.) It is ovate, obtuse, *serrated*, or toothed like a saw.

Fig. 2. A leaf *elliptical*, obtuse, entire.

Fig. 3. The leaf of the Daisy (Bellis perennis.) It is *spatulated*.

Fig. 4. The leaf of the black bryony, (Tamus communis.) It is *cordiform*, acute, entire, basinerved.

Fig. 5. The leaf of the white Water Lily, (Nymphæa alba.) It is cordiform, obtuse.

Fig. 6. The leaf of the Asarabacca, (Asarum Europæum.) It is reniform, obtuse, and *emarginate* at the top.

Fig. 7. A sagittate leaf.

Fig. 8. An hastate leaf.

Fig. 9. The leaf of the Marsh Pennywort, (Hydrocotyle vulgaris.) It is *orbicular*, doubly crenated and peltate.

Fig. 10. The upper leaves of the Woodbine, (Lonicera caprifolium.) They are connate.

Fig. 11. The leaf of the Bupleurum Rotundifolium. It is oval, acute, perfoliated.

Fig. 12. The leaf of the Hydrocotyle tripartita. Thumb. It is *cuneiform*, five-toothed.

Fig. 13. The leaf of the Dandelion, (Taraxacum dens leonis.) It is pinnatifid and *runcinate*.

Fig. 14. The leaf of the Groundsel, (Senecio vulgaris.) It is pinnatifid, *lyrate*.

Fig. 15. The leaf of the glacous-leaved Passion Flower, (Passiflora glauca.) It is three parted, with lanceolate, acute, serrated lobes.

Fig. 16. The leaf of the Passiflora Cærulea. It is five-parted, digitate, with lanceolate, sinuated lobes.

FOURTH PLATE. Compound Leaves.

Fig. 1. The leaf of the Orange Tree, (Citrus Aurantium.) It is compound, *unifoliolate*.

Fig. 2. A paripinnated leaf, or pinnated without an odd leaflet, bijugate.

Fig. 3. The leaf of the Ash, (Fraxinus excelsior.) It is imparipinnated, or pinnated with an odd leaflet.

Fig. 4. Unijugate leaf.

Fig. 5. Digitate and trifoliolate leaf.

Fig. 6. The leaf of the Horse Chesnut, (Æsculus hipocastanum.)

It is digitate, septemfoliolate, with leaflets which are obovate, acute, toothed.

Fig. 7. Leaf of the Mimosa Julibrizin. It is decompounded, bipinnate.

Fig. 8. A decompounded, triternate leaf. (Epimedium Alpinum.)

FIFTH PLATE. Flowers.

Fig. 1. Lilach, (Syringa vulgaris.) The corolla, regular, monopetalous, *hypacrateriform.*

Fig. 2. Tobacco, (Nicotiana Tabacum.) Corolla, monopetalous, regular, *infundibuliform.*

Fig. 3. Campanula. Corolla, monopetalous, regular, *campanulate.*

Fig. 4. Corolla, monopetalous, regular, *urceolated.*

Fig. 5. The floret of a cardoon.

Fig. 6. A semiflosculous floret.

Fig. 7. The monopetalous, regular, *personate* corolla, of the Antirrhinum Linaria.

Fig. 8. A monopetalous, irregular, *bilabiate* corolla.

Fig. 9. The Wall-flower, (Cheiranthus annuus.) The corolla polypetalous, regular, *cruciform ; a* one of the petals.

Fig. 10. The Pink, (Dianthus caryophyllus.) Corolla polypetalous, regular, *caryophyllaceous.*

Fig. 11. Strawberry, corolla polypetalous, regular, *rosaceous.*

Fig. 12. Corolla polypetalous, regular, *papilionaceous.*

SIXTH PLATE. Stamina and Pistils.

Fig. 1. The Lily, (Lilium candidum.) Ovary free, three-ribbed, style larger at the top, snd terminating in a three-lobed stigma.

Fig. 2. Dog-rose, (Rosa canina.) Several parietal ovaries attached to the wall of a monosepalous, urceolated calyx.

Fig. 3. Hedge Hyssop, (Gratiola officinalis.) Ovary free, style very long, stigma bilamellated.

Fig. 4. Gooseberry, (Ribes grossularia.) Ovary inferior, surmounted by a two parted style.

Fig. 5. Ovary three-celled, or trilocular.

Fig. 6. A stamen whose anther is bilocular, cordiform.

Fig. 7. The anther of a Solanum, opening by a pore at the top of each cell.

Fig. 8. A Laurel, (Laurus nobilis.) The anther two-celled, the cells opening by small flaps: *a a* the openings of the cells: *b b* the flaps.

Fig. 9. Virginian Spiderwort, (Tradescantia Virginica.) Stamina whose filament is covered with jointed hairs: the anther is bilocular, twin: the two cells are separated by the connective *a*.

Fig. 10. Ten monadelphous stamina.

Fig. 11. Ten diadelphous stamina.

Fig. 13. Five syngenesious stamina.

Fig. 14. Common Birthwort, (Aristolochia clematitis.) Ovary inferior, raised into ridges; stamina united with the style and stigma, that is gynandrous.

Fig. 15. Grasses. Spikelet one-flowered: *a a* the two valves of the lepicene: *b b* those of the glume, embracing the pistil and the three stamina.

Fig. 16. The same, stripped of the lepicene and glume: *a a* the two scales of the glumella.

SEVENTH PLATE. Seeds and Germination.

Fig. 1. Seed of the Kidney Bean: *a* hilum, *b* micropile.

Fig. 2. The same stripped of its proper integument or episperm that is to say the embryo alone: *a* the radicle, *b b* the two cotyledons.

Fig. 3. The same, one of the cotyledons being removed: *a* the radicle, *b* the caulicle, *c c* the gemmule.

Fig. 5. A germinating Kidney Bean. The radicle is seen shooting out.

Fig. 6. The Castor Oil seed, (Ricinus communis:) *a* the ariliform caruncula.

Fig. 7. The same cut longitudinally: *a* the caruncula, *b* the endosperm, *c* the embryo.

Fig. 8. The embryo separated from the interior of the albumen: *a* the radicle; *b b* the cotyledons, *c* the gemmule.

Fig. 9. The same seed cut across.

Fig. 10. A seed of the Indian Shot, (Canna indica,) cut longitudinally: *a* its episperm, *b* its endosperm, *c* its embryo, which is monocotyledonous.

Fig. 11. The embryo of the former seed separated: *a* the cotyledon, *b* the gemmule enclosed in the cotyledon, which, in growing, pierces the cotyledon laterally, and becomes *b*; *c* the radicle enclosed in the coleorhizon, which it must pierce at *c* in order to sink into the earth.

Fig. 12. Wheat, (Triticum sativum,) its monocotyledonous embryo being laid bare.

Fig. 13. A Kidney Bean which has germinated: *a* the radicle, *b b* the two cotyledons, which are become seminal leaves, *c* the stem, *d d* the leaflets of the gemmule, forming the two primordial leaves.

Fig. 14. A seed of the Indian Corn, (Zea maïs,) germinating: *a* the body of the seed, formed of the farinaceous albumen, *b* the cotyledon which is lengthened, and which contained within it the gemmule, which has pierced it at its upper and lateral part (*c*); *d* the coleorhizon, which contained the principal radicle, *e* the point where the radicle *f* has pierced the coleorhizon, *g g g*, radicles.

EIGHTH PLATE. Fruits.

Fig. 1. Siliqua.

Fig. 2. Silicula.

Fig. 3. The legume of the Pea.

Fig. 4. The capsule of a Lychnis opening by teeth at its upper part.

Fig. 5. A two-celled, many-seeded capsule.

Fig. 6. A Samara.
Fig. 7. The gland of the Oak.
Fig. 8. The drupe of a Peach Tree.
Fig. 9. Melonida or Pomum.
Fig. 10. Pyxidium.
Fig. 11. A Follicle.
Fig. 12. Achenium crowned with a sessile feathery pappus: *a* one of the hairs detached.
Fig. 13. Achenicum crowned with a stipitate, hairy pappus.

THE END.

ERRATA.

Page 17, line 3, *for* fig. 6, *read* fig. 7.
—— 151, —— 2, *for* banyans, *read* bananas.
—— 153, —— 22, *for* organic, *read* agamic.
—— 343, —— 17, *for* shews, *read* shew.
—— 377, —— 25, *for* pericarp, *read* epicarp.
—— 391, —— 25, *for* fig. 4, *read* fig. 7.
—— 406, —— 17, *for* hydrogen, *read* nitrogen.
—— 478, —— 21, *for* each, *read* each other.
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